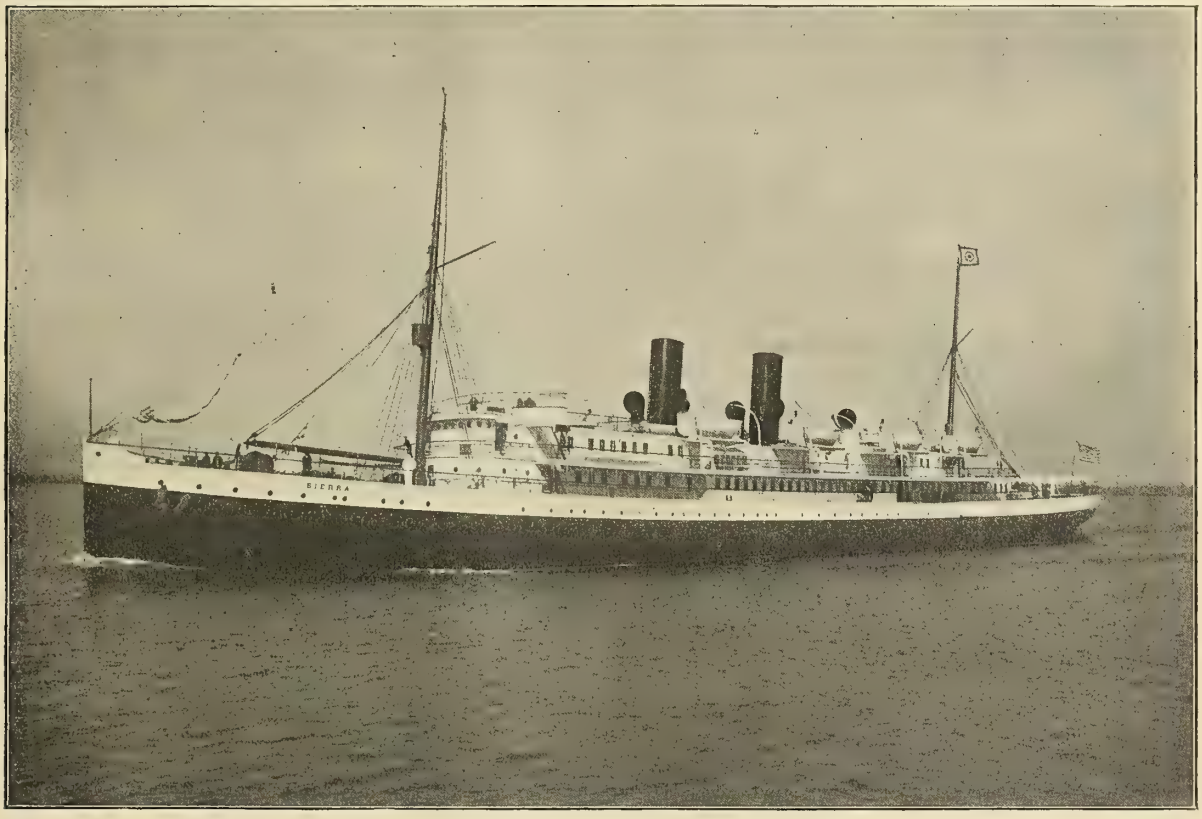
MARINE ENGINEERING.

Vol. 6. NEW YORK, MARCH, 1901. No. 3.

STEAM PIPE EXPLOSION ON S.S. VENTURA INSTANTLY KILLS FIVE MEN.

When on her maiden trip from the builder's yard at Philadelphia to her home port, San Francisco, the new steamship *Ventura* met with a mishap that caused the immediate death of five men and injured four others. This vessel is one of the three sister ships built by the William Cramp & Sons Ship and Engine Building Co. for the Oceanic Steamship Co. (Spreckels line)—the S.Ss. *Sierra, Sonoma,* and *Ventura.* They are of the following dimensions: Length between perpendiculars, 400 ft.; beam, 50 ft.; depth, 26 ft.; gross tonnage, 6,200 tons. They are twin screw vessels, with triple expansion engines, having cylinders 28 in., 46 in. and 76 in. dia., and 48 in. stroke. The boilers, of which there are eight, are the usual return tube type, 13 ft. 6 in. dia. and 10 ft. 5 1-2 in. long, built for a working pressure of 175 lb. per sq. in. The grate surface is 390 sq. ft. and heating surface 14,975 sq. ft.

These vessels operate under a U. S. mail contract to maintain a service between San Francisco, Auckland, New Zealand, and Sidney, New South Wales, touching at the Hawaiian and Samoan Islands.



STEAMSHIP SIERRA OF THE OCEANIC STEAMSHIP CO.'S FLEET—SISTER SHIP TO THE VENTURA AND SONOMA.
(Photograph, copyright 1900, by Detroit Photographic Co.)

Extraordinary interest has been taken by marine engineers of the Pacific coast in the investigation into the causes that led to the fatal accident on board of the *Ventura,* which happened in lat. 30 deg. 58 min. So., long. 87 deg. 42 min. West on January 23 last. The *Ventura* arrived at San Francisco on February 8 and reported that five of her engine room force had been killed by the bursting of the main steam pipe of the

(Copyright, 1900, by Aldrich & Donaldson, New York.)

port engine. The men had been instantly killed—steamed alive. Their bodies were buried at sea the day following the accident and the *Ventura* proceeded on her way to the port of destination.

The fact that a sister ship of the *Ventura*, the *Sierra*, built at Cramps' shipyard in Philadelphia, had arrived at San Francisco a month or so before the unfortunate *Ventura* with her machinery in a pretty bad mess, started the rumor in engineering circles that the vessels were not as smooth a job as Cramps are wont to turn out, but the subsequent work of the *Sierra* proved that the roughness of her machinery was merely superficial. Another sister ship, the *Sonoma*, has given a good account of herself, and now interest on the coast centers almost entirely on the *Ventura* accident and the investigation that is now being carried on by the local U. S. inspector of steam boilers, J. K. Bulger.

When the pipe let go the *Ventura* was making good time, but was not being forced. Had the accident not occurred she would have broken the record of the *Sonoma* from the Atlantic side, and even as it was she came in only 14 hours behind the *Sonoma's* time. The trip was made in 38 days, 23 hours and 50 minutes.

The break in the pipe occurred in the tunnel way between the engine room and the fireroom, close to the engine room bulkhead, as shown in the accompanying rough sketch.

On February 11 the Local United States Inspectors of Hulls and Boilers, J. K. Bulger and O. F. Bolles, called the witnesses in the case and put Captain H. M. Hayward on the stand first.

Captain Hayward stated that at the time of the mishap the weather was very fine and the vessel was running at a moderate speed, about 15 1-2 knots—her contract speed was 17 knots. The ship was not being driven hard, nor had there been any attempt to drive her since leaving Philadelphia. After leaving Philadelphia a southwest gale had been encountered, but the ship withstood the heavy seas, and there was no sign of straining. The fastest run made on the trip was nearly 388 knots and the smallest 323 knots. Asked whether the vibrations were more apparent when the vessel was going slow than when going full speed, the master said that there was no perceptible vibration at all when the vessel was going half speed.

Chief Engineer S. N. Haines stated that he had held a license for sixteen years. The average revolutions, when running at full speed on the *Ventura*, were about 98, and upon referring to the log book it was found that the revolutions for the day of the mishap were 90.2, and on the previous day 105. Four hours previous to the explosion, the revolutions were about 101 on both the starboard and port engines. The boilers had primed a little during the voyage, so that it had become necessary to slow down the engines. At the time of the explosion the witness was in his room preparing for dinner. He went to the engine room immediately and ordered the throttle to be kept open, not knowing where the fracture was at the time. As soon as possible he got into the fireroom and had the fires hauled in the forward boilers, and just as soon as possible afterward in the after fireroom, all the fires being hauled within twenty-five minutes after the mishap occurred. He examined the fracture within an hour of the explosion, and said that it was on the brazing, and as near as he could judge from the appearance of the fracture, he formed the opinion that the pipe was burned in the brazing. After the furnaces cooled he went inside of them and could see no evidences of burning. One fusible plug had blown out, but this was after the accident, and the crown sheet was not injured in any way.

Asked if he had noticed the way in which the steam pipe flanged on the engine room bulkhead, he said there was a doubling plate for stiffening on the bulkhead and the connection was rigid, but he thought that there was enough expansion on the pipe from the tunnel to the curve where the main pipe joined the boiler. The elbow was made of cast steel. When the pipes in the tunnel were disconnected he noticed that the flanges were separated about one-half an inch. He said he thought that if the pipe had been re-enforced it would not have let go, and when asked how he would re-enforce it, replied, "With bands."

The boilers connect with the main steam pipe by a branch pipe from the main boiler into the main steam pipe, but he did not think that the hangers supporting the steam pipe were suspended properly—that there should have been more of them—but he thought that the pipes would ride over the braces without interference. He believed that the hangers to hold the steam pipes should lead from the top and not from the side.

In reply to a question, he said that he did not think that a stuffing box and gland on the engine room bulkhead would have helped the case any. The expansion joint was located in the after fireroom. He said it was packed with asbestos, and he did not believe there could be any play in it—that any slip joint when packed hard was "liable to become solid." If it were not packed solid it would be likely to blow some. On further questioning he said that if expansion had taken place and the slip joint had become solid he did not think that a flange on the engine room bulkhead would have any tendency to burst the pipe. He did not think that any water hammering had occurred in the pipe, and in reply to a further question, he said that he did not believe there was any drain on the main pipe. His own practice had always been to drain into the condenser. There was no panting on the bulkhead, nor any vibrations that he could observe. Asked if he thought that a 3 ft. U on the pipe would have prevented the mishap, he said that if the fracture was due to defective workmanship he did not know whether a U would have prevented it or not.

Asked whether any other mishap had occurred, he said that on the voyage out "the suction feed let go in three places on the line of the brazing"—"due to defective workmanship." The exhaust from the port engine circulator had also given out. This was a copper pipe 5 in. dia.

At the conclusion of the examination the question was put:

"Have you any theory of your own to offer on the explosion of this pipe?"

"In my opinion it occurred from defective workmanship."

On the following day, when the examination was resumed, Chief Engineer Haines said that after reaching San Francisco the fractured pipe was taken out and sent

to the Risdon Iron Works. The fractured section was cut out and the two ends were reflanged and a new center piece put in. The pipe was then re-enforced with steel bands, which were put on at intervals of about 4 or 5 in. at his request. He understood that the pipe was then subjected to a hydrostatic test of 350 lbs.

Asked whether the connections between the engine room stop valves on the bulkhead and the throttle valves on the engine were too rigid, he said that he believed that they were, but the only leak developed on the voyage out was shown by a little salt on the cross connection between the port and starboard pipes. He had not heard of any similar trouble, however, on any of the sister ships.

M. McGinn was next sworn. He had made the voyage on the *Ventura* as "builders' engineer," representing Messrs. Cramp. He acted simply in an advisory capacity. He said that at the time of the accident he had formed no opinion as to what had been the cause.

"Have you formed any opinion since?"

"I think that it was caused by undue priming of the boilers and the strain on the pipes."

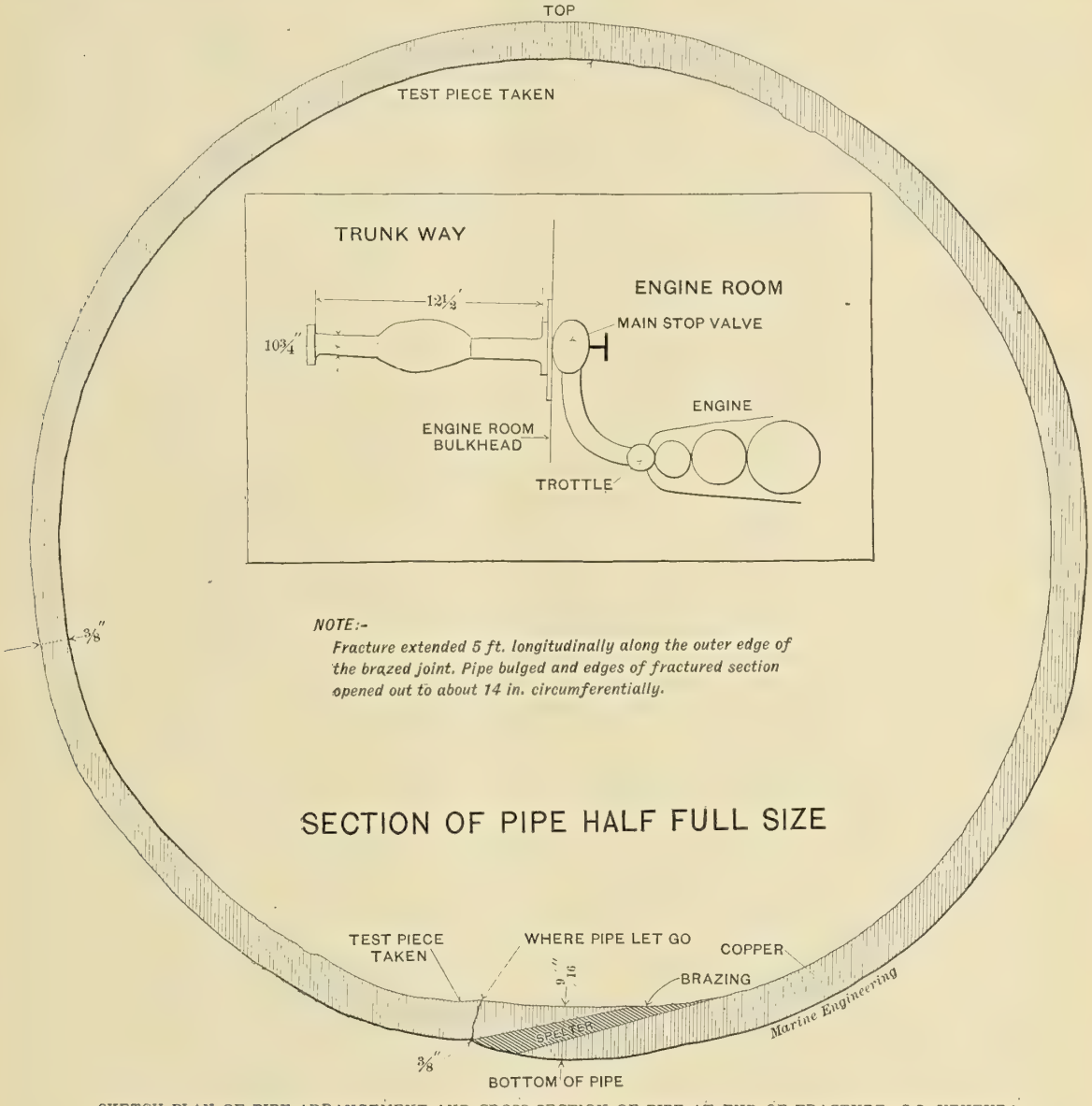
He said that he had heard that the boilers primed, but not sufficient to stop the engines.

Asked if he had noticed the hangers on the steam pipes of this ship, he said he had not, and neither had he noticed the slip joint. He did not know whether the pipes had been tested by Lloyds or not and he was not present when the vessel was tested by the U. S. inspectors. He saw the starboard main steam pipe after the joints were broken and noticed that there was an opening of about 1-2 in. between the lengths.

"Do you think it was natural?" was asked, to which the witness replied:

"I don't know."

The witness was asked if he had seen the pipes since



SKETCH PLAN OF PIPE ARRANGEMENT AND CROSS SECTION OF PIPE AT END OF FRACTURE—S.S. VENTURA.

they were re-enforced and banded, and in reply said that if they had been banded in that way, he did not think they would have let go (that is, for the size of the break). He did not think that the break would have been as long, but thought that the pipe would have given out between the re-enforcements.

Asked why he thought that, he replied:

"If the pipe was unduly strained and showed a weak spot, it would have given out at that spot.

The witness said that the pipes on the port and starboard sides were alike, but he did not know whether there had been any strain on the port pipe. The boilers primed on both sides, and in reply to an inquiry as to why the pipes did not carry away under the same strain, he said he did not know.

Asked if there was enough expansion in the slip joint, he replied that the elbow in the pipes would have taken the full amount of the expansion. The expansion joint on the forward boiler would not take up the expansion in the trunk way, but it was the intention for the slip joint to take up the expansion from the turn or elbow in the pipe outside of the trunk way in the fire room. In reply to an inquiry, he said that in some cases a slip joint when packed was defective, but he did not know whether it was so in this case or not. Re-enforcing the pipe with bands would, he believed, have prevented such a large fracture, but it would not in his opinion have held the pipe intact. The other pipes that burst on the way out were the suction pipe from the feed; the small T connection in the auxiliary exhaust pipe.

Asked what he attributed this failure to he replied: "To defective brazing." He had never known of the bursting of steam pipes by water hammering, but had known of a case (the S.S. *St. Paul*) of the failure of a valve on the main steam pipe. In that case the valve was connected to the bulkhead.

The results of the test made on pieces cut out of the fractured pipe were shown to the witness, and he said that he was satisfied that the tests were fair.

Following is the result of the test:

Sample No. 1, .375 thick, 1 in. wide, breaking strain 11,675 lb., tensile strain 31,120 lb., reduced thickness .25 1-2, reduced width .75, elongation in 8 ins., 18.7 per cent, ductility 49 per cent.

Sample No. 2, thickness .375, width 1 in., breaking strain 12,000 lb., tensile strain 32,236 lb., elongation 34.3 per cent, ductility 50 per cent, reduced thickness .25, reduced width .75.

In reply to a question Mr. McGinn said that he did not examine the pipes on top of the boilers at any time during the voyage, as he came on the ship in an advisory capacity exclusively.

First Assistant Engineer Thomas Lawrence, who had served his time in the Cramp shipyard, said he was on watch when the accident occurred. The engines were making about 105 or 106 revolutions and they were carrying about 165 lb. of steam. When the explosion occurred he went into the forward No. 2 fireroom, and the steam had all died down when he examined the pipes. On close questioning he said that the cause of the disaster in his opinion was "an inferior quality of copper."

Asked why he thought it was inferior, he said that

(*Continued on page 90.*)

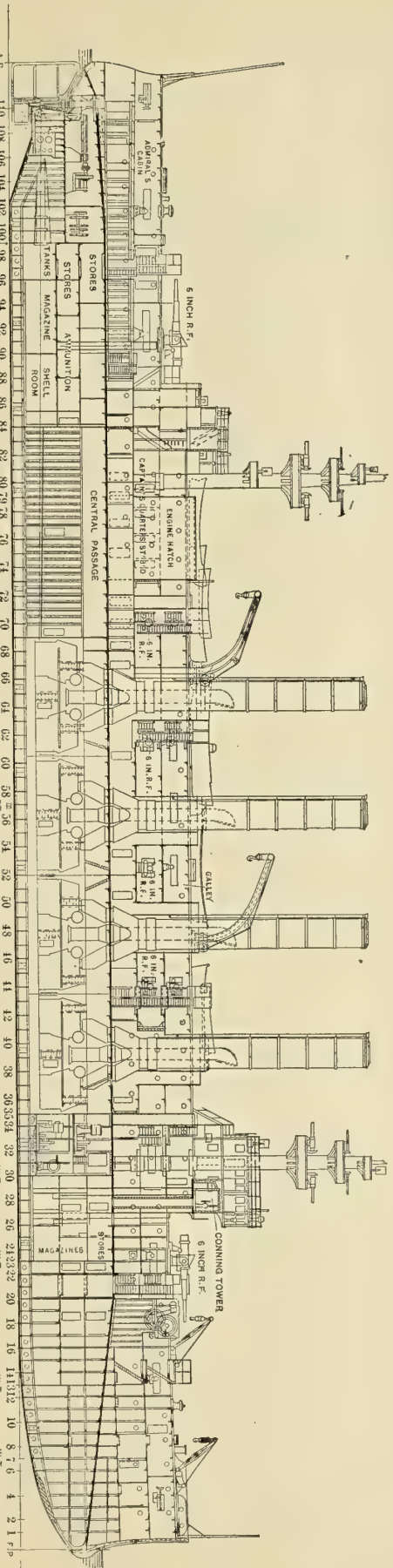
COMMENT ON THE NEW TYPE OF UNITED STATES PROTECTED CRUISERS.

BY T. H. THOMAS.

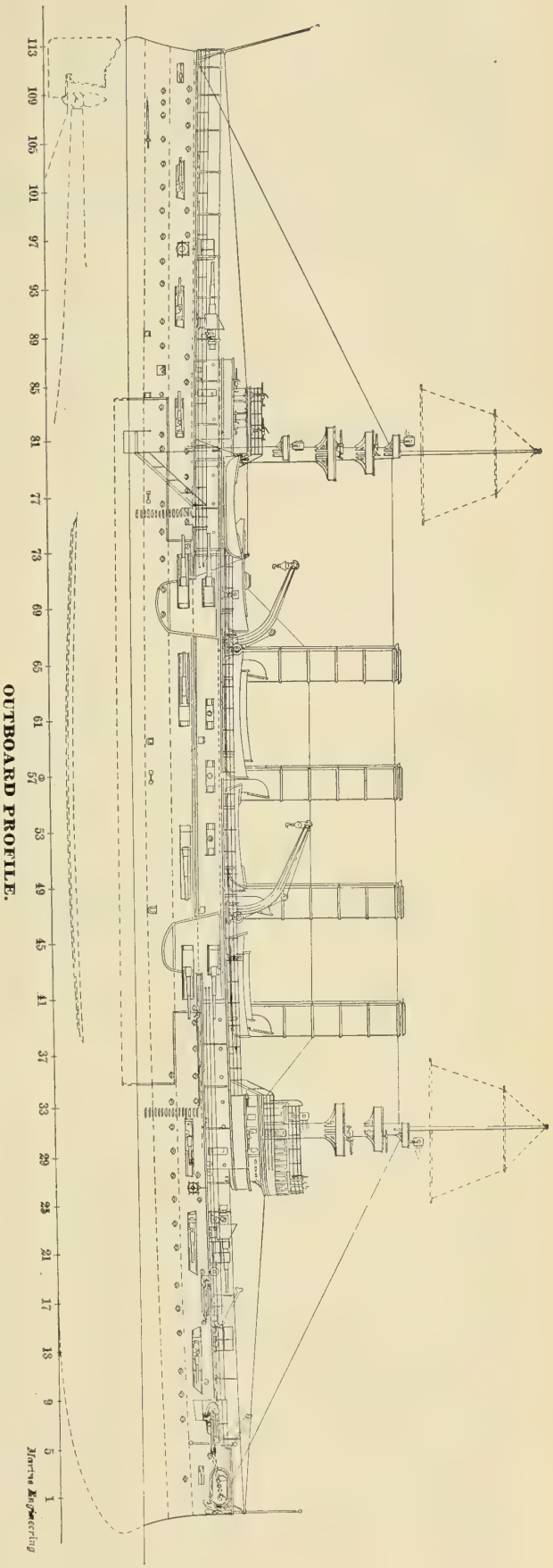
The three new cruisers, *St. Louis, Milwaukee* and *Charleston,* although not yet laid down, have had a most interesting history. In the naval programme of 1899 were three protected cruisers, but the provision authorizing them was struck out by Congress; the next year the three cruisers reappeared in the programme, but with a displacement of 8,000 tons, and were so authorized by Congress. It soon became evident that their displacement was by no means settled upon; rumors were heard that the Naval Board of Construction could not agree upon the matter, and then the particulars of the disagreement were made public by the publication of the minority report on the design of the cruisers, and, later, the rejoinder of the majority of the Board. It appeared that the majority had approved of a design which called for an unsheathed vessel of 9,500 tons, 22 knots speed, 1,500 tons bunker capacity, and which carried a battery of 14 16-in. guns, 18 3-in., 12 3-pdrs., and 24 smaller guns. The minority report, which was signed by Chief Constructor Hichborn alone, provided for a sheathed vessel of 8,500 tons, 23 knots speed, and unarmored, whereas the larger ship was to be protected by a belt of 4 in. armor over a good portion of her side, and over her 6 in. guns. In other respects, the designs were substantially the same.

It was claimed by the chief constructor, Admiral Hichborn, that Congress, in providing for protected cruisers, had not intended vessels with side armor; that foreign navies—the Russian and French particularly—were building protected cruisers of 23 knots speed, and that the United States could not afford to fall behind them in this respect; and that the vessels proposed by the majority could not be built for the money appropriated. The majority replied that the intention of Congress as to armoring the vessels was not known; that the term "protected cruiser" did not necessarily mean a ship without armor; that moderate protection for ship and gunners was more valuable than one extra knot of speed, and that the only way to find out whether the ship could be built within the limit of the appropriation was to invite bids. Also it was asserted that the Spanish war had shown sufficiently the danger of leaving gun crews without protection against rapid fire guns, while the more recent *Belleisle* experiments have shown the destructive effect of high explosive shell bursting between decks. This view prevailed, and the cruisers will be built after the plans of the majority report.

This step is decisive and of far-reaching importance to the United States navy. It may be said to be the first official confirmation of the doctrine that no fighting vessel of even moderate size should be built without armor over her water line and gun positions. In the United States navy it may be hailed as the doom of the first class protected cruiser and the institution of a new and most interesting type of armored cruisers. This type, while classed as armored cruisers, will not be called upon to perform the same duties as their more powerful predecessors, which, as a rule,



INBOARD PROFILE.



OUTBOARD PROFILE.

PLANS OF THE ST. LOUIS CLASS U. S. PROTECTED CRUISERS, DISPLACEMENT 9,700 TONS, SPEED 22 KNOTS, RECENTLY CONTRACTED FOR.

are really very fast second class battleships, and which will perform much the same duty as battleships. Nor will they be expected to oppose them. Instead, these new vessels, while a distinct type, are essentially nothing but *perfected* fast protected cruisers, and will be called upon for the same duties as have been expected from protected cruisers. They carry armor, not to enable them to lie in the line of battle, but because modern weapons have made it necessary to carry armor in order to perform the duties which heretofore have been expected of unarmored ships; their speed is slightly less, not because high speed is considered unnecessary, but because the addition of armor necessitated a sacrifice of other advantageous features.

The growth of this new type, while very recent and rather spasmodic, is none the less steady and rational. France may be credited with the first example of the type, the *Dupuy de Lome*, launched in 1890. But the French are fickle in their theories of naval construction, and dropped this one for a time. The Elswick type of fast, heavily armed, protected cruiser then came to the front; and has held its position until the last year or so, as the late date of the Russian *Variag*, one of the best examples of the type, attests. The Russians, while among the last to give up the Elswick type, early adopted the new one, launching, in June, 1900, the *Bayan*, a very good example of the new type. France has returned to it in the *Dupleix* class, and England has now adopted it, the *Essex* class being, perhaps, better specimens of the type than either the *Bayan* or the *Dupleix*—certainly better ships. Finally, with the adoption of the new type by the United States, the beginning of the century will mark no greater event in naval construction than the passing of the large protected cruiser.

Bids for the construction of the three protected cruisers, authorized by Act of June 7, 1900, were opened at the Navy Department on February 1, 1901. Four bids were received as follows:[1]

The Neafie & Levy Ship & Engine Building Co. (Class 1 Prosposal).

For one cruiser at $2,740,000.

To be built in accordance with the Department's plans and specifications, with the exception of the following items, which are to be eliminated from the specifications:

Interior communication system. Water tight doors operated by power. Hatch covers operated by power. Awnings and canvas work. Bronze pilot house. (One of wood to be substituted). Cellulose. (To be supplied by the Government). Linoleum. (To be supplied by the Government).

Newport News Shipbuilding & Dry Dock Co. (Class II. Prosposal).

For one cruiser at $2,741,000.

To be built in accordance with the Department's plans and specifications, with the exception of certain changes in the specifications. These changes made in hull specifications are too numerous to give in detail and practically consisted of re-writing the specifications.

Machinery specifications: Refrigerating pipes to, and coils in magazines to be omitted.

Bath Iron Works. (Class II. Proposal).

For one cruiser at $2,750,000.

To be built in accordance with the Department's plans and specifications, with the exception of certain changes in the specifications: The changes made in the hull specifications are too numerous to give in detail and practically consisted of re-writing the specifications. Machinery specifications: Refrigerating pipes to and coils in magazines to be omitted.

William R. Trigg Co.:

No formal proposal was submitted, but in a letter to the Secretary the company stated that it would agree to build one of the cruisers for $2,780,000, or two for $5,480,000, being $2,740,000 each, provided no reduction was made for the purchase of armor, and provided further that the items enumerated in the following list were stricken from the specifications:

Electric work under Bureau of Equipment; electric ammunition hoists, Bureau of Construction & Repair; long arm doors; refrigerating plant, Bureau of Steam Engineering; Spare propellers; Spare crank shaft; blue prints of complete machinery; workshop machinery, Bureau of Steam Engineering; hydraulic pumping plant; cooling plant for magazines; cellulose; splinter bulkheads; power operation of hatches; hand pumps; laundry machinery and fittings; mess lockers; tracings of working hull plans, to be submitted instead of furnished; deck covering of linoleum, rubber, mats, cement, compressed cork or otherwise; spare parts for auxiliaries under C. & R.; fireproofing of wood decks; electric fans and spare parts; all apparatus necessary to facilitate rapid coaling under all conditions; hose and attachments; common tents; hospital tents; wall tents; cots; tarpaulins; life belts and cork life preservers; hand and leg irons; hammock bags; coaling bags; windsails; windsail bags; coaling slings; coaling trucks; candle stands; sponge bath tubs; combined water coolers and filters; deck mats; carpenters' breeches; scotchman; can hooks; handy billy pumps; heaving lines; wash deck implements; sand.

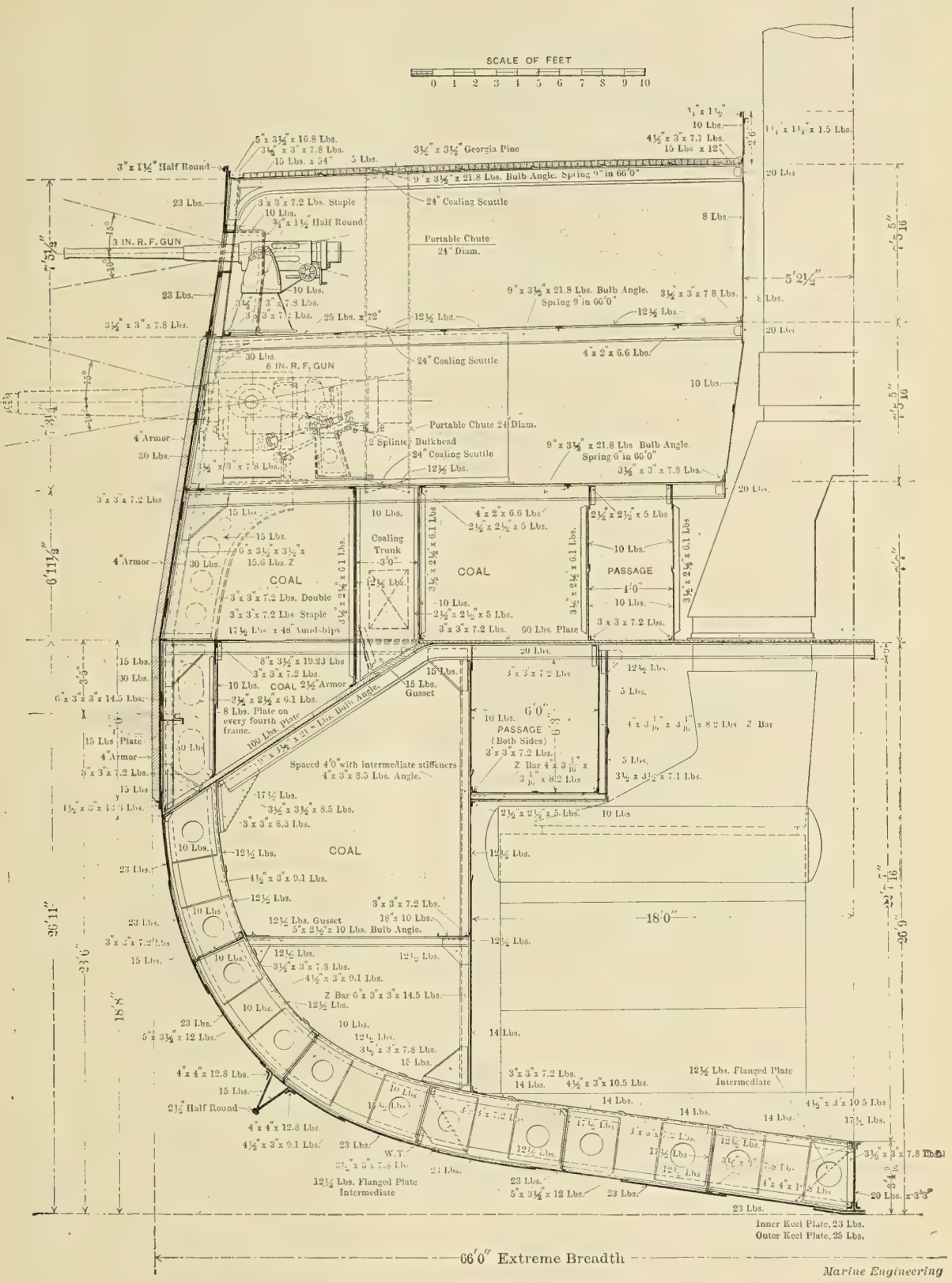
It was decided to tender an offer of one ship to The Neafie & Levy Ship & Engine Building Co., at $2,740,000, provided they adhered to the Government specifications and restored the following items eliminated from the specifications in their bids, viz.: (1) Interior communication system. (2) Awnings and canvas work. (3) Bronze pilot house. (4) Linoleum.

That in place of these items, the following items, the same as had been eliminated from the specifications of the battleships and armored cruisers should be eliminated, viz.: (1) Refrigeration of magazines. (2) Laundry machinery. (3) Chiffoniers. (4) Mattresses and pillows. (5) Drilling gun mounts and furnishing the securing bolts therefor.

This tender was accepted by the Neafie & Levy Co.

Tenders were also made to the Newport News Co. and Bath Iron Works, being the next lowest bidders, at the same price ($2,740,000), and under the same conditions. Up to the time of going to press, these concerns have not been heard from.

[1] Note: All proposals, both Class I and Class II, are for vessels of a trial displacement of 9,700 tons, of 22 knots speed, and to be delivered within 36 months from date of contract.



CROSS SECTION ST. LOUIS CLASS U. S. PROTECTED CRUISER—NOTE SIDE ARMOR.

(*Continued from page 86, column 1.*)

"it looked hard and brittle near the seam," and when asked why it should look so, he said, "it looked as though the copper had been burnt."

About a week previous to the accident, the boilers had primed, but the water had not been elevated very much. The priming was sufficient to be noticed, however, and the engines were slowed down. There were no drains on the main steam pipes, there being drains only on the bleeders.

In reply to further questioning he said that he did not think that the bands that were suspending the pipes were properly hung, as they should have been hung overhead. He said that the slip joint on the main steam pipe was packed with asbestos and was tight, and in reply to an inquiry as to whether an expansion joint, when packed, allowed the pipe sufficient play, he replied: "I do not think it does." Asked if the pipes had been wrapped with wire or banded would they have let go? he said, that in his opinion, they might have let go, but the rent would not have been so large.

Water Tender John King, who testified that he had had twenty-three years of sea service, said that on the night of the accident there was about 4 in. of water in the after set of boilers, and a little more in the forward set of boilers.

Asked if there was any priming when he was on watch, he replied: "One time we gave her a little soda and she made a little kick." He did not observe any leaks around the checks or any leaks in the main steam pipe.

Second Assistant Engineer J. V. Ainsworth said he was on watch about 2 1-4 hours before the accident; at that time the boilers were not priming. On previous watches there had been priming and the water came over into the cylinders.

This concluded the evidence so far as those who were on the ship were concerned, and we understand that application has been made by the local inspectors to headquarters to determine whether expert testimony of persons who were not on board at the time of the accident is permissible.

S.S. Oregonian.—The steamship *Oregonian*, building for the American-Hawaiian Steam Ship Co., at the Roach shipyard, was launched last month. The *Oregonian* will run between San Francisco, Honolulu and New York, and is of these dimensions: Length, 435 ft.; beam, 51 ft.; depth, 33 ft. 6 in., and 12,500 tons displacement. She will be fitted with triple expansion engines of 3,000 I. H. P., with cylinders 28 in., 46 in. and 75 in. with 4 ft. stroke. She will have four Scotch boilers 14 ft. 9 in. dia. by 10 ft. 6 in. long.

On her westward voyage, which ended at New York February 8, the Hamburg-American line S.S. *Fuerst Bismarck* broke her starboard crank shaft. The line of fracture was such that the shaft held together while the engine was being stopped, and no damage resulted. At New York a spare was substituted.

The premature explosion of a shell disabled one of the 13-in. guns in the main battery of the battleship *Kearsarge* recently. The gun will be taken out at Norfolk and sent to the Washington yard for examination and repairs.

AMENDMENTS TO THE U. S. STEAMBOAT RULES AND REGULATIONS FOR 1901.

At the annual meeting of the U. S. Board of Supervising Inspectors of Steamboats, held in Washington in January, with Supervising Inspector General James A. Dumont in the chair, the usual annual amendments to the rules were considered and finally sent to the Secretary of the Treasury for his approval. This having been received the amendments are now in effect.

Following is the text of the rules amended in part only, the parts struck out inclosed in brackets [thus], while the additions to such paragraphs are printed in *italics*. Entirely new sections and paragraphs of sections are in plain type preceded by the word (new) in parentheses.

RULES.

Rule II.

Section 30. (Seventh paragraph.)

The flanges of all copper steam pipes over 3 inches in diameter shall be made of bronze or brass composition, shall be securely brazed to pipe, and shall have a thickness of material of not less than four times the thickness of material in the pipes plus .25 of an inch; and all such flanges shall have a boss of sufficient thickness of material projecting from the back of the flange a distance sufficient to be properly *brazed or* riveted to the pipe. * * *

Section 38. (Fifteenth paragraph.)

No connection between shell of boiler and mud drum [exceeding 6 inches in diameter will be allowed] *shall exceed 9 inches in diameter, and the flange of the mud drum leg shall consist of an equal amount of material to that cut out of the shell of boiler.*

Section 40.

* * * No cast-iron flanges will be allowed to be used on boilers for marine purposes unless such cast iron has been [officially] tested and [test on] *affidavit of such test furnished by the manufacturer for* record in the office of the local inspectors where boiler with such appliances was constructed, and no cast iron with a tensile strength of less than 30,000 pounds will be permitted to be used for such purposes. Semisteel of not less than 24,000 pounds tensile strength may be used for nozzles, [stop valves,] branch pipes, elbows, slip joints, flanges to boilers, tee pipes, and water and gauge cock pipes or columns, when said semisteel has been [officially] tested, and [test on] *affidavit of such test furnished by the manufacturer for* record in the office of the local inspectors, same as is required of cast iron.

Section 40. (New paragraph.)

Throttle or stop valves attached to steam chests of steam engines, boilers, or superheaters, also casings of slip joints in steam pipes, may be made of cast iron, when made suitable thickness and proper material, for pressure allowed on boiler.

Rule III.

Section 12.

The total capacity of lifeboats, or of lifeboats and life rafts, on steamers, navigating the ocean, except steamers [100] *150* gross tons and under hereinafter pro-

vided for, shall not be less than the capacity given, according to tonnage, in the following table:

Boat capacity required on steamers navigating the ocean.

Gross tons.	Total capacity of boats.
Steamers over— [100] *150* and not over 200	540 cubic feet.

Lifeboats required on steamers navigating northwestern lakes, bays and sounds.

Gross tons.	Number of boats.	Capacity of boats.
Steamers over— [100] *150* and not over 200	2	360 cubic feet.

Number of tons (gross).	Number of boats.	Dimensions.			Factor.	Contents.
		Length.	Breadth.	Depth.		
Steamers over—		*Feet.*	*Ft. in.*	*Ft. in.*		*Cubic feet.*
100 and not over 150	1	20	5 6	2 6	.7	192.5

SECTION 23.

Table of dimensions of boats for passenger steamers of [100] *150* gross tons and under, navigating lakes, bays, sounds and rivers whose waters flow into the Gulf of Mexico. Boats of other dimensions of equivalent cubical capacity may be used. *One-half the boat capacity required may be substituted by its equivalent in approved life rafts.*

SECTION 24.

All steam vessels certificated as ocean, at their annual inspection after the adoption of this rule (except vessels of [100] *150* tons and under, inspected under the provisions of section 4426, Revised Statutes, and freight and towing steamers, inspected under the provisions of section 4427, Revised Statutes) shall be provided with a line carrying projectile and the means of propelling it, such as may have received the formal approval of the Board of Supervising Inspectors.

Rule V.

SECTION 5. (First paragraph.)

No person shall receive an original license as engineer or assistant engineer, except for special license on small pleasure steamers of 10 tons and under, and ferryboats, sawmill boats, pile drivers, *boats exclusively engaged as fishing boats*, and other nondescript similar small vessels navigated outside of ports of entry and delivery, who has not served at least three years in the engineer's department of a steam vessel, a portion of which experience must have been obtained within three years preceding the application: * * *

SECTION 14. (New, at end of ninth line of section.)

It being further provided that masters of barge consorts on the Great Lakes having had three years' experience as such master and who hold license as first-class pilot may be examined and licensed as master of steam vessels.

SECTION 14. (Third paragraph.)

[No original license as master of ocean or coastwise steamers shall be issued to any person who has not had three years' experience on steam or sail vessels preceding the application, one year of such experience to be as chief mate of steam vessels. No original license as chief mate of ocean or coastwise steam vessels shall be issued to any person who has not had three years' experience on steam or sail vessels, and must have served one year as second mate of steam vessels, such service to be immediately preceding the application. No original license shall be issued to second mate of ocean or coastwise steam vessels who has not had three years' experience in the deck department of steam or sail vessels immediately preceding the application, one year of such service to be on steam vessels.]

No original license as master of ocean or coastwise steam vessels shall be issued (except as hereinafter provided) to any person who has not had at least three years' experience on seagoing or coastwise steam vessels, one year of such service to have been as chief mate of such vessels; nor shall any person receive an original license as chief mate of ocean or coastwise steam vessels who has not served at least three years in the deck department of such steam vessels, one year of such service to have been as second mate of such vessels. Applicants for license as second mate of ocean or coastwise steam vessels must have had at least three years' experience on such vessels, one year of such service to have been as quartermaster or third mate on such vessels. Applicants for license as third mate of ocean or coastwise steam vessels must have had at least three years' experience on such vessels as a mariner or

quartermaster. It is provided, however, that persons whose experience at sea has been on sail vessels of over 700 gross tons may be licensed on the following conditions, namely:

Master.—Any person who has had five years' experience on such sail vessels, two years of which must have been as master of such sail vessels, may be licensed as master of ocean and coastwise steam vessels.

Chief mate.—Any person who has had five years' experience on such sail vessels, two years of which he has served in the capacity of chief mate, may be licensed as chief mate of ocean and coastwise steam vessels.

Second mate.—Any person who has had three years' experience on such sail vessels, one year of which has been in the capacity of second mate, may be licensed as second mate of ocean and coastwise steam vessels.

Third mate.—Any person who has had three years' experience on sail vessels as mariner may be licensed as third mate of ocean and coastwise steam vessels.

* * *

Rule VI.

SECTION 7. (First paragraph.)

Certificates of inspection for any period less than one year shall not be issued, but nothing herein shall be construed as preventing local inspectors from inspecting steamers for renewal of certificate, upon due application in writing, at any time not exceeding [thirty] *ten* days of expiration of current certificate of inspection, providing the same can be done without greater expense than would be incurred if taking place when inspection is regularly due, and that such inspection shall not interfere with other inspections regularly falling due at the same time. This rule, however, is not to be construed as preventing the inspection of any steamer at an earlier period than [thirty] *ten* days anterior to the expiration of the steamer's certificate, when such steamer has been practically rebuilt, or when necessary "for the purpose of concentrating the work of the inspectors within certain given periods"

* * *

Rule IX.

SECTION 8. (New paragraph to precede first paragraph.)

It shall be the duty of local inspectors to insert in the blank spaces provided therefor in the authorized certificates of inspection of all steam, gas, fluid, naphtha or electric motor vessels, a sufficient number of licensed officers, firemen, and deck crew, to at all times manage the vessel, also the proper number of watchmen in the cabins, and upon each deck, to guard against fire and other disasters, and to give alarm in case of accidents.

SECTION 8. (Fourth paragraph.)

It shall be the duty of all inspectors before granting an original license or renewing an existing one to a master or pilot of steam vessels for any waters, *who has not been employed as master or pilot of steam vessels on such waters during the three years preceding the application for renewal,* to satisfy themselves, by an examination in writing, *or orally, to be taken down in writing by the inspectors,* that such officers are thoroughly familiar with the pilot rules upon the waters for which they are licensed.

SECTION 14. (First paragraph.)

When it is known or comes to the knowledge of the local inspectors that any steam vessel is or has been carrying an excess of steam beyond that which is allowed by her certificate of inspection, [it is recommended that] the local inspectors in whose district said steamer is being navigated, in addition to reporting the fact to the United States district attorney for prosecution, under section 4437, Revised Statutes, shall require the owner or owners of said steamer to place on the boiler of said steamer a lock-up safety valve that will prevent the carrying of an excess of steam and shall be under the control of said local inspectors.

Pacific Coast Wood Schooner.

The sailing schooner *Minnie A. Caine,* recently launched at the yard of the Moran Bros. Co., Seattle, Wash., is a fine example of Pacific Coast practice in building wood vessels. Her dimensions are: length, 215 ft.; beam, 41 ft.; depth of hold, 14 ft. 9 in. The entire hull, spars and finishing are of Puget Sound fir. The schooner is heavily built and has large carrying capacity—on her first trip she carried 11,000 ft. of lumber. She is schooner rigged, with four masts and topmasts, and, in addition to the usual sails, has a large square sail on the foremast. For handling the sails and cargo she is fitted with a powerful steam hoisting engine, and is also provided with steam pumps. The cabin arrangement and finish is superior to that of many steam vessels, and the furniture and other equipment is arranged with the comfort and convenience of those who live aboard in view. The first trip is to Australia.

Another fine vessel of this class under construction at the yard is the barkentine *James Johnson,* which is 231 ft. long on the upper deck.

There is a large demand on the Pacific Coast for such vessels, and all the Puget Sound yards are busy. Such vessels, we are informed, have paid owners a net profit of more than 40 per cent per annum during the past four years.

Past and Present Fleet.

An unusual little incident of the seas is recorded in the accompanying photograph, taken recently, by George M. Roche, off Queenstown Harbor. It shows the new Cunarder *Ivernia* coming down the Irish channel bound for Boston, Mass., and in the distance, at anchor, the German four masted bark *Theodor,* at one time the crack Cunarder *China.* It thus represents the meeting of the first Cunard screw steamship and the latest of the fleet, the magnificent *Ivernia.*

Old timers will recall that the Cunard line held to the side wheel steamer tenaciously, the last of this type in its fleet being the famous *Scotia,* a vessel of 3,800 gross tons and 4,900 I. H. P., which came out in 1862. In the same year the line built its first screw steamship, the *China,* and though she was neither as large nor as speedy as the *Scotia,* she was a very fine and popular vessel. The *China* was built at the Napier yard on the Clyde, and her dimensions were: Length between perpendiculars, 326 ft.; beam, 40 ft. 5 1-2 in.; depth moulded, 29 ft.; gross tonnage, 2,539 tons. She was originally fitted with a single screw driven by

oscillating geared engines, with cylinders 80 in. dia. and 66 in. stroke, developing 2,250 I. H. P. Her average rate of speed was 13.9 knots, and coal consumption about 82 tons in twenty-four hours. The *China* was so successful that she established the supremacy of the screw propeller in the line. In process of time this vessel was surpassed by other and larger screw steamers, and was sold out of the line. Finally, after her machinery had been removed, she was purchased by a shipping firm of Bremen, and rigged as a bark. She now flies the German flag.

The *Ivernia*, a sister ship to the *Saxonia*, represents the highest development of the modern intermediate steamship. She was built by C. S. Swan & Hunter on the east coast of England last year. Her dimensions are: Length between perpendiculars, 582 ft. 6 in.; depth moulded from upper deck, 41 ft. 6 in.; gross tonnage, 13,800 tons. She is fitted with twin screws driven by quadruple expansion engines of about 10,000 collective horse power, and has a sea speed of about 15 knots. The *Ivernia* is now in the Cunard service between Boston and Liverpool.

MEETING OF THE OLD CUNARDER CHINA AND THE NEW CUNARDER IVERNIA IN THE IRISH CHANNEL.

Turbine Passenger Vessel.—At the Denny yard a passenger vessel for Clyde trade, to be fitted with Parsons turbine engines, is under construction. She is 250 ft. long, 27 ft. beam and 6 ft. 6 in. draft. Turbines of 4,000 horse power are expected to give her a speed of 20 knots. She will have Scotch boilers.

PACIFIC COAST SAILING SCHOONER MINNIE A. CAINE, BUILT BY MORAN BROS. CO., SEATTLE.

THE U. S. LIFE SAVING SERVICE SELF BAILING WATER BALLAST SURFBOAT.

BY LIEUT. C. H. M'LELLAN, R.C.S. ASSISTANT INSP.

At this season of the year, when the work of the United States Life Saving crews attracts public notice almost daily for its skill and effectiveness, attention is especially directed to the forms of apparatus used on our coasts. We here propose to describe one of the most useful and recent improvements in appliances for the service, viz.: the Beebe McLellan self bailing water ballast surfboat.

The term surfboat is applied to the light boats of the service, which are placed at all of the stations, and are transported on wagons from the station to the vicinity of the wreck; while life boats because of their great weight are used only at those stations where they can be launched into protected water from a cradle running on tracks.

The dimensions of the surfboat in question are:

Length over all	25 ft. 4 in.
Greatest breadth	7 ft. 0 in.
Depth amidships	2 ft. 7 in.
Sheer of gunwale	1 ft. 11 in.
Sheer of keel	5 in.
Weight, about 1,300 lbs.	

Its distinctive feature is its self bailing quality, which is accomplished by its deck, so placed that when the boat is loaded to its greatest capacity, it is above the level of the water on the outside, thus rendering self bailing possible by means of six square tubes on each side of the keel.

The tubes are provided with valves at their tops, which close when water strikes them from the inside of the tubes and prevents its ingress to the boat, and which open on the slightest pressure from the outside, permitting the water to flow from the boat. The valves are constructed in the simplest manner, and can be renewed with tacks, leather and hammer, if they become injured at any of the isolated stations.

The side air chambers under the thwarts are for the twofold purpose of additional buoyancy in case of the boat being filled, and to throw the water amidships to the relieving tubes.

A water ballast tank is provided by which the boat can be ballasted with about 300 lb. of water ballast, should necessity require it. The water is admitted to the tank through a valve well in the after end of the center board trunk, the valve being wedged shaped. The tank can be freed of water if the boat is afloat by pumps, or through the valves if on the beach.

The boat is propelled by eight 12 ft. oars, double banked, and a mainsail and jib are provided for long distances. Righting lines are secured at the ends of each thwart, sufficiently long to reach over the bottom of the boat to the opposite side, when the boat is bottom up. These are to assist the crew in righting the boat in case of an upset, and one of the exercises of the Service require the capsizing of the boat under proper conditions, in order to drill the men in righting and climbing into it, and also to clear themselves from the boat in case of an upset.

The advantages of this boat over the old style, square stern, open surfboat, are many, the chief of which may be explained as follows: with the open boat, when going off the beach in a heavy surf, if the seas fill the boat, one or more of the crew must lay in their oars and bail the boat. This, of course, delays the boat's progress to the wreck. Or if the boat is completely filled, it must be brought back to the beach and emptied, which is a dangerous evolution, as in its waterlogged condition the boat is liable to capsize. In trying to avoid the heavy seas and prevent being filled, much valuable time is lost—a serious drawback where lives are in danger.

With the self bailing surfboat, if a sea comes on board and fills it even with the rails, it empties itself in twenty seconds, and is ready to meet the next run of seas. With such an advantage, the men have little fear of an upset, and there is no time lost in waiting for favorable chance, as the boat cannot be swamped.

Since its introduction, the crews have made rescues with it on our outlying shoals and bars which would not have been attempted with the old style open boat. There are about two hundred of these boats in the Service, and they are rapidly superseding the old boat.

The men of one crew on the New Jersey coast, who have made some of the most perilous rescues, declare, that if they had to go back to their old open boat, they would leave the service.

CONSTRUCTION OF BEEBE M'LELLAN SURFBOAT.

In detail the construction of the Beebe McLellan self-bailing water ballast surfboat with centerboard is as follows:

The keel is of white oak, 2 in. thick, 9 3-4 in. wide amidships, and rabbeted 7-8 in. in width for the planks. The ends are steamed and bent up to shape.

Stem and stern posts are of white oak, sided 2 in., molded 4 in. at the gunwale, and 5 in. at scarf of keel, overlapping the keel 8 in. and each lap is fastened by three galvanized 1-4 in. bolts driven and riveted over burrs. These stems are cut from timber with natural crook to suit the shape and are protected on the outside with 1-16 in. galvanized iron straps from the ringbolts to 1 ft. beyond the scarfs, the width of the straps conforming to the width of the stem and stern posts.

Frames are of bent white oak, siding 7-8 in. and molding 1 1-8 in. and are cut to fit the planking. The floor timbers running across the keel are at least 4 ft. 9 in. long amidships, and are formed of knees at the ends of the boat. They are placed 12 3-4 in. from center to center amidships and closer at the ends, as shown in the plan. Futtocks are placed alongside of each floor timber; also between each of the floor timbers amidships and spaced as shown on the plan.

Outside planks: There are ten on each side of the boat, of 1-2 in. thick white cedar, each plank not more than two pieces, with 7-8 in. laps, and fastened with six-penny copper nails riveted over burrs, one through each frame, one between amidship frames,

and two where the distance between futtocks increases. The hood ends are fastened with galvanized iron nails. The bevel scarfs lap 2 in., covered on the inside by 1 1-2 in. by 5-8 in. white oak strips, with six rivets passing through both, with burrs. At the bottom of the upper strake there is a batten of white oak 7-8 in. square, rounded on the outside and extending the whole length of the boat.

At the bottom of the other planks there are battens 1-2 in. by 7-8 in., the upper one 7 ft. long and at equal distances from each end of the boat, and each batten below increases in length at each end of the distance of each frame. The five lower battens are of white oak, the next four above of cedar. An outside molding batten at the height of sheer is of white oak, 2 in. deep, 7-8 in. thick, and rounded on the outside; the fastenings passing through the frames and inner gunwale.

Gunwales and breasthooks: Inner gunwales are of white oak, 2 in. by 7-8 in., fastened at the ends into white oak breasthooks made of natural crook-knees, with 5 in. throat, 14 in. arms, and 2 in. deep. The breasthooks are riveted through the stems and are also fastened with three rivets on each side through the outside planks and battens.

Thwarts are four in number, placed 8 in, below the top of the gunwale. They are of 8 in. by 1 1-4 in. spruce, with three white oak natural crook knees on each end on top, siding 1 in., and with arms on thwart 13 1-2 in. long; each thwart where not supported by the center-board trunk has, amidships, a 7-8 in. support underneath, with cleats under the thwarts and steps on deck.

Seats at the end are of 5-8 in. white cedar, supported by 1 in. by 2 in. spruce carlins; part of the forward seat is removable. The tops or covering boards of the side air cases are continuations of the after seat. Inboard ends of forward and after seats are supported by 5-8 in. cedar planks. A 5-8 in. hole is bored in the inboard end of the forward and after seats on each side, near the upper carline and the outer plank, into the side air cases for ventilation, as shown on the plan.

Deck is of 5-8 in. white cedar, 4 in. wide, extending the whole length and width of the boat, resting on spruce carlines 2 in. by 1 in., halved on each frame and fastened with two galvanized boat nails passing through both. The deck planks are fastened by five-penny galvanized iron nails, set in and beeswaxed. A drain pipe 1-2 in. dia. and 6 in. long is inserted on each side of the deck at the lowest point of the sheer, within the side air cases to drain them into the hold. The deck within the side and end air cases is covered with muslin, laid with English marine glue and ironed on.

Air cases: The side boards of the air cases are of 5-8 in. cedar, reaching from their covering boards to the deck, and fastened to strips 7-8 in. by 1-2 in. nailed to the deck. A brass screw ventilator of 1 in. opening is placed in each of the sideboards of the side air cases near the top.

Delivery tubes are made of 7-8 in. white pine, jogged over the frames, fastened to them and outside planking, and provided on each side above the deck with 2 1-2 in. by 4 1-8 in. openings. Inside of these openings are valves of sheet rubber fastened to the inside of the tubes by two brass screws passing through a protecting strip; on the bottom they have three to four ounces of lead clinched on by copper tacks. On each side of the opening on the inside of the tubes are strips of cedar running from nothing at the top to 1-4 in. at the bottom, put on with galvanized brads and with paint between them and the boxes. Underneath these side strips is a cleat V, shown on the plan, the top of which is even with the top of the deck. It is 1 1-2 in. deep and siding 3-4 in. at base of rabbet, which is grooved 1-2 in. by 1-2 in. out of the upper inner edge, leaving 1-4 in. of wood; from the 3-4 in. thickness at the rabbet it is tapered to 1-4 in. in thickness at the base.

Top of boxes is of 5-8 in cedar, fastened with 1 1-4 in. brass screws. The tubes taper in both directions, as shown on the plan.

Water-ballast tank—its feed and delivery, and centerboard trunk, and centerboard: A water-ballast tank, 10 ft. long, 18 in. wide, and 6 in. deep, made of 3-4 in. pine, is built around a combination centerboard trunk and water-ballast tank well, which has an opening 5 ft. 6 in. by 1 1-4 in. for the former and 1 ft. by 1 1-4 in. for the latter, separated by an oak post 2 in. by 1 1-4 in., and with similar posts at the ends, reaching in depth from the top of the keel to the under side of the thwarts. There are oak sills to the trunk, 3 in. by 1 1-4 in., secured to the keel by nine 3-8 in. copper bolts riveted over washers. The sides of the trunk are of 1 1-4 in. white pine or cedar tongued and grooved, and securely doweled to the sills, all joints being laid in white lead and cotton.

The centerboard is of 7-8 in. oak, securely doweled together and hung with a fork, having a 1-2 in. galvanized iron rod and 1-2 in. king bolt.

The sides and ends of the tank are cut at the timbers to fit closely to, and are fastened up through, the bottom of the boat. The bottom of the tank is fitted in around the well as low down as the frame of the boat will allow and all seams are calked and payed. The inside of the tank is covered with light canvas put on with marine glue and ironed, and painted with two coats of lead and the top of the tank on the outside is treated in the same manner.

The tank is divided into five compartments by four 3-4 in. partitions, leaving 1-4 in. space under and over each partition for drainage, and with five 1 1-2 in. holes in each partition for the free circulation of water. The tank is secured between stanchions from the carlins to the timbers.

A brass deck plate with 3 in. opening is placed in the top of the tank on each side of the valve well to free the tank of sand if necessary, and is made accessible by leaving a square section of the deck over the plates removable.

The water is admitted to the tank through an opening in each side piece of the well, 4 in. long by 2 in. wide, which is closed by a wedged shape gate hinged to a screw bolt 3-4 in. dia. This is raised and lowered by an open bell-shaped nut which engages the plate across the top of the well. All parts of the gates and the bolts are of gunmetal.

Each frame is fastened to the inside of the well by ten hexagonal headed screw bolts, and is 1-8 in. thick at the top, increasing to 3-8 in. thick at the bottom and 7 3-4 in. by 6 1-4 in. outside dimensions, with an opening 4 in. long by 2 in. wide.

The gate is 6 in. long by 5 3-4 in. wide by 1 in. thick at the top, by 1-2 in. thick at the bottom, and is held in place by guides cast on each frame, 1-2 in. square at the top, and tapering to 1-2 in. by nothing at the bottom. The gate and frames are planed to engage water-tight when in position and closed.

The 3-4 in. bolt is widened and flattened at the lower end to 2 in. where it hinges to the gate between two lugs 1 in. wide, with a 3-8 in. pin having a split key. The bolt has a flat cut thread of 5-32 in. pitch, extending 4 in. below the nut when the gate is closed.

The plate across the top of the well is 4 in. long and 2 in. wide at the ends, where it is bent down 1 3-4 in. to embrace the sides of the well, and is expanded at the center to a segment of a circle 3 in. dia.; it is 5-16 in. thick and is fastened at each end by two screws in the side of the well.

The open bell-shaped nut has a socket 1 1-4 in. deep and 1 3-4 in. dia.; the height of the top of the rim above the plate is 2 1-4 in.; the outside diameter of the upper rim is 6 in. and the four connecting arms are 7-16 in. dia., expanded at the rim and socket.

On top of the rim of the nut there is distinctly stamped or engraved a double headed arrow, 2 in. long, the left head of the arrow pointing to the word "Close;" the right head to the word "Open."

An air vent of IA lead pipe of 5-8 in. inside dia. is inserted into and tacked to the top of the tank, the other end opening into the well box; the part in the tank is expanded bell shape in which a 3-4 in. glass ball is suspended by copper wires.

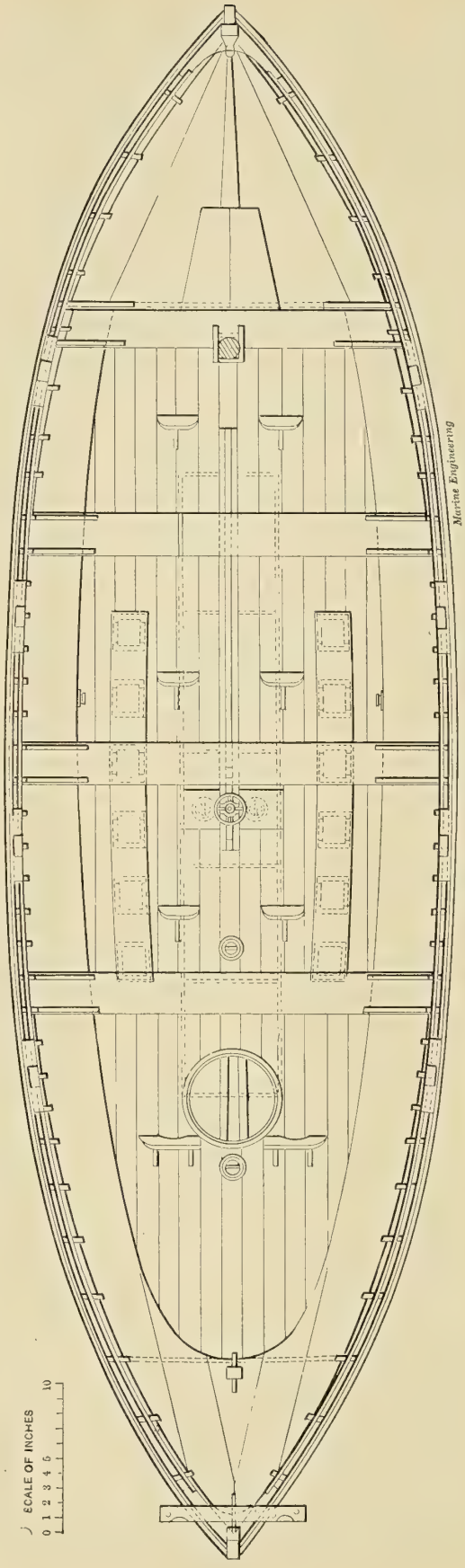
A brass pump of 2 3-4 in. dia., reaching to 1-4 in. of the bottom of the tank, viz., 11 in. long, is inserted in the tank, and a copper pipe surrounding it has a sleeve tacked water-tight to the top of the tank and is turned over at the top of the deck.

Bitts and cleats: Bitts and cleats of white oak are fitted forward and aft, as shown in the plan.

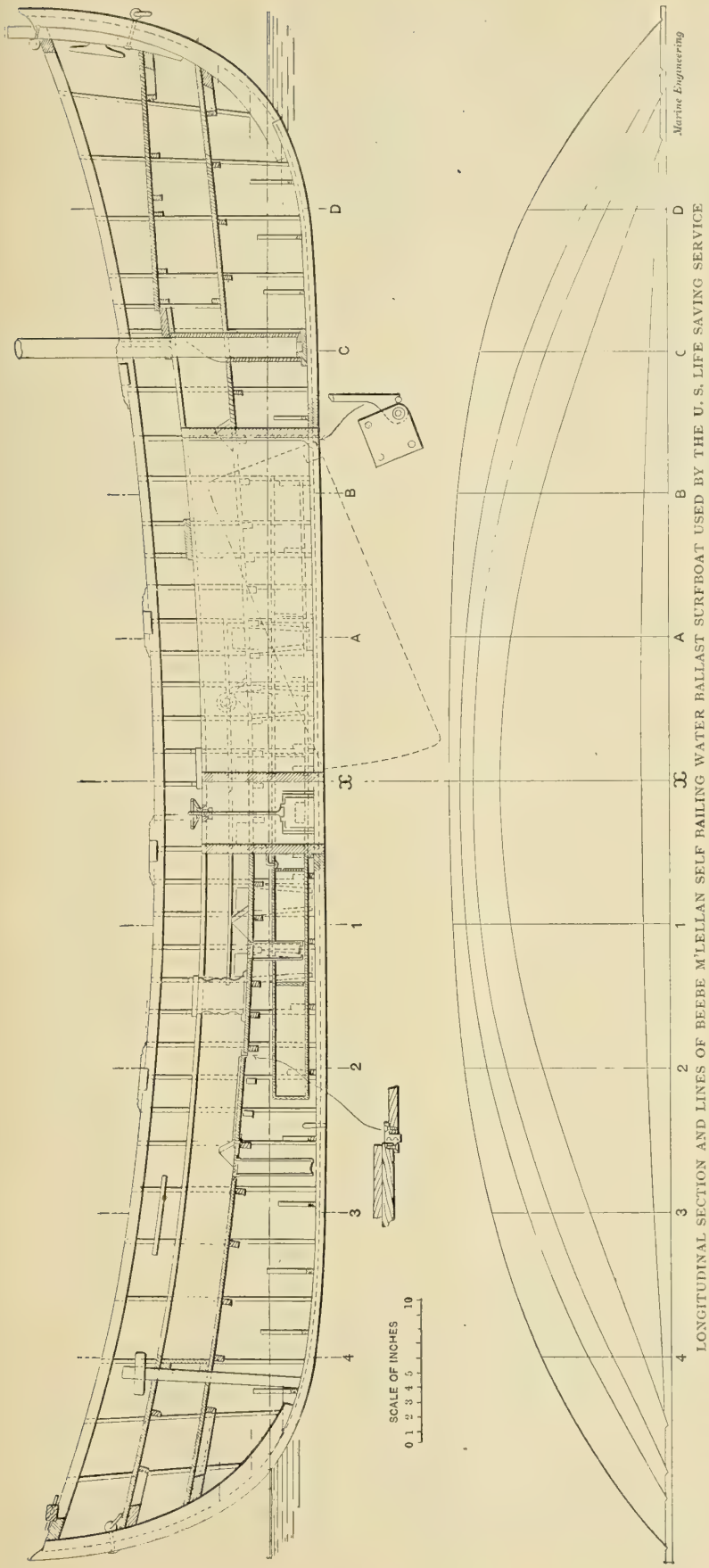
Ringbolts: Ringbolts are passed through both stems, of 5-8 in. galvanized iron, with rings of 3 in. opening.

Oarlock beds are of white oak, 15 in. long and 1 in. thick strengthened with a copper rivet through each end outside of the thole-pin hole are fitted for thole-pins and oarlocks and fastened to the outer planks and inside gunwale by copper rivets. They are partly let into the inner gunwale. The center of the oarlocks is about 10 in. abaft the after edge of the thwarts, and the center of the thole-pins are 5 in. apart.

Sterling-oar plank: A white oak plank, 2 ft. 5 in. long, 3 in. wide, and 2 in. thick, is fastened to the top of the after breasthook by three 3-8 in. galvanized iron bolts with nuts underneath the breasthook, leaving a space of 4 in. between it and the sternpost. A 1-2 in. galvanized iron belay bolt passes through it horizontally amidships above the breast-



CONSTRUCTION PLAN OF THE BEEBE M'LELLAN SELF BAILING WATER BALLAST SURFBOAT.



LONGITUDINAL SECTION AND LINES OF BEEBE M'LELLAN SELF BAILING WATER BALLAST SURFBOAT USED BY THE U. S. LIFE SAVING SERVICE

hook. A 5-8 in. hole near the outer fender and a 7-8 in. hole 4 3-4 in., center to center, outside of the same, are bored vertically through each outboard arm of the plank for the passing through of a 1-2 in. (dia.) manila rope, with knots underneath the 5-8 in. holes. This rope holds the steering oar in place, and is belayed over the iron pin. The plank is hollowed out for the oar on the upper after edge.

Manhole.—The manhole is 17 1-2 in. dia., with a gunmetal ring fitted around it. On the top is cast a flange, 1 in. wide, and on the bottom a flange extending inside of the opening 1-2 in. The cover is of cedar 7-8 in. thick, the top being 1-2 in. above the deck and fitted into a gunmetal flanged ring 7-8 in. deep, and with a flange on the bottom 7-8 in. wide. The flange is under cover and secured to it with brass screws. The two rings are to screw into each other and all parts are 1-4 in. thick. On top of the cover there are fastened with copper rivets two oak battens slightly out of parallel, and to the space between them is fitted a tapered oak wrench.

Bilge keels with hand-holes are placed outside of the planks over the fourth lap from the keel. They are of white oak 10 ft. 6 in. long, 1 5-8 in. deep and siding 1 1-4 in. at plank, tapered to 7-8 in. at outer edges and rounded; the hand-holes are 5 in. long and 3-4 in. in the clear, leaving about 1 3-4 in. solid wood at each frame. They are fastened through each frame by a 3-16 in. copper nail, riveted over a burr on the inside.

Pump: There is in the hold of the boat and in the tank a brass pump of 2 3-4 in. inside dia., with rubber boxes on the brass cross seat.

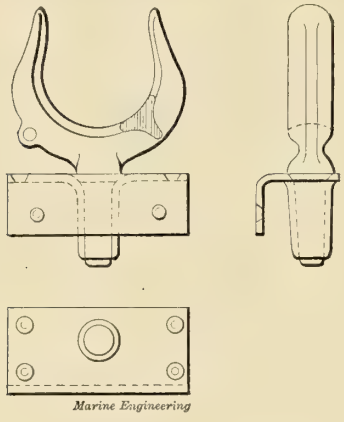
Plug: A white pine plug is inserted into the keel abaft the tank and accessible through the manhole.

Righting lines: On each side of the boat abreast of each thwart are righting lines of 18 thread manila, 3 fathoms long, spliced around the inside gunwale, and provided at the other end with floats of neatly turned cedar, 4 1-2 in. long and 3 in. dia. at the center tapered to 2 1-4 in. at ends, and having holes longitudinally through their centers sufficiently large to reeve the lines. A Mathew Walker knot is worked in the lines before and after the float is put on, to confine the float to the end of the righting line.

Calking: The deck and air cases are carefully calked with cotton and white leaded.

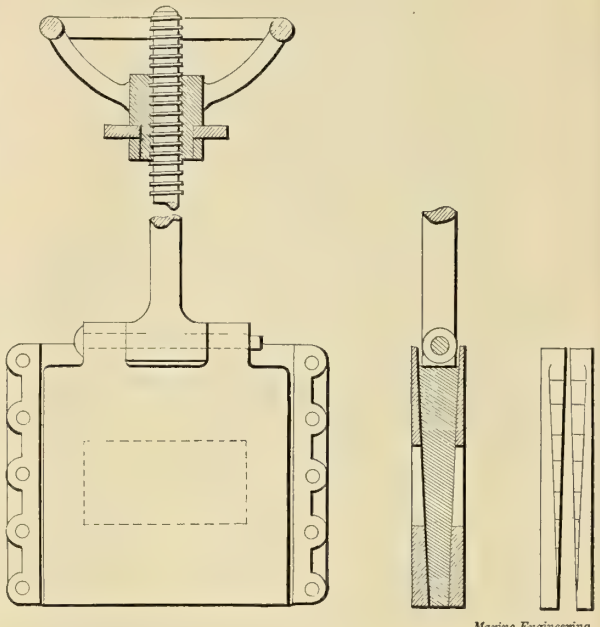
Paint: The outside of the boat is painted with two coats of good oil paint, green to the water line and white from there to molding batten, which is colored blue. Gunwales and inside of boat have two coats of spar varnish. The words U. S. Life Saving Service are placed on each bow on the third plank in black letters 3 in. high.

Spars are of spruce: There is a mast 17 ft. long,



DETAILS of OAR LOCKS—SEE PAGE 96.

rope is spliced into the eyes of the withe on each side, and belays to gunmetal pins through thethroat of the thwart knees. Single gunmetal blocks for the

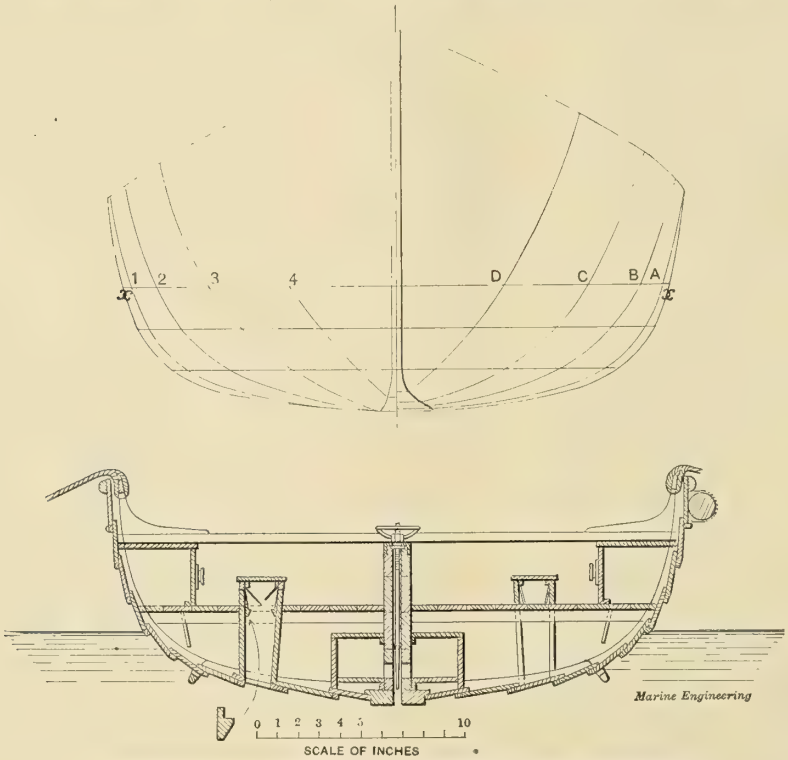


DETAILS OF GATE AND FRAMES—SEE PAGE 96.

4 in. dia. at the thwart, and 2 3-4 in. at the head. The heel is squared to fit the sleeve between the thwart and step. The head is fitted with gunmetal withe, 1 3-4 in. wide, with four 1-2 in. eyes for shrouds and halyard blocks. One shroud of 1 1-2 in. Russia hemp

halyards are hooked in the other eyes of the withe. Two sprits of spruce, 18 ft. and 15 ft. 6 in. long, 2 1-2 in. at the center and tapering to 1 in. at the ends, are supplied.

Mast thwart and hasp: The mast thwart is of oak



CROSS SECTION AND BODY PLAN OF BEEBE M'LELLAN SURFBOAT.

of the same dimensions as the other thwarts, and located as on the plan. A half circle is cut in the thwart to receive the mast, and fitted with a gunmetal hasp to complete the circle, 1 1-4 in. wide and 1-4 in. thick, hinged on the port side, and fastening on the starboard side over a staple, with chained key.

Mast sleeve and step: A water-tight square sleeve, 4 1-8 in. by 4 1-8 in., of 1 in. oak, open on the after side above the deck extends from the keel to, and is secured under, the thwart, the lower end being secured to the step. A movable cover is fitted to close the opening of this sleeve when the mast is not stepped, the lower end resting on the deck abaft the opening, the upper end under the thwart against the forward side of the sleeve. A 2 in. galvanized iron ring is fitted to the cover. The step is of oak, 2 in. thick and of the width of the inside measurement of the sleeve, with mortise for the heel of the mast, and securely bolted to the keel.

Sails: Spritssail and jib is of No. 10 cotton duck, 14 in. wide. Roping is of 15 thread Russia hemp bolt rope, excepting the luff of the jib, which is of 1 1-4 in. iron rope of the same quality. Reef bands are placed one-third of the distance up from the foot of the sails, with reef points of cotton stuff. There are eleven worked eyelets in the luff of the spritsail, including nock and tack, and eleven galvanized iron mast hoops large enough to work freely on the mast. Brass thimbles are in all the cringles. There are double sheets for both sails, the jib sheets leading aft through fairleaders. The halyards for both sails lead through single gunmetal blocks at the masthead. The jib has a snap hook in the tack for hooking into the stem eyebolt. Two gunmetal belay pins are placed in the thwart on each side of the mast. A wooden cleat is fitted on each side aft, for the mainsheets; the cleat is fastened to two frames. A sail cover of No. 10 cotton duck is furnished to cover both sails when furled on the mast.

Oars: There are ten 12 ft. ash oars, of first quality of wood, yacht dressed, the looms leathered, and tips of blades coppered.

Cork fenders are of No. 6 cotton duck, solidly stuffed with ground cork, 4 in. dia. for one-third of their length in the middle, gradually diminishing to 2 in. dia. at the ends wehere they are flattened and an eye worked for the seizing. They extend to within one foot of the stem and stern, and are secured to the upper plank between two rows of brass screw eyebolts, with 3-8 in. eye, 1 ft. apart and with cross lacing of cotton stuff to fit the eyes.

S.S. J. L. Hutchinson.—The steel cargo steamer *J. L. Hutchinson* was launched from the Cleveland yard of the American Shipbuilding Co. last month. The boat was built for the Pioneer Steamship Co. of Cleveland, and is of these dimensions: Length, 366 ft. over all; 346 ft. keel; beam, 48 ft.; depth, 28 ft. She will be fitted with triple expansion engines with cylinders 22 in., 35 in., and 58 in. by 42 in. stroke. Steam will be furnished by two cylindrical return fire tube boilers of the Scotch type. The boat will cost about $215,000 complete.

TORPEDO CRAFT (UNITED STATES AND FOREIGN) TYPES AND EMPLOYMENT.*—VI.

BY LIEUT. R. H. JACKSON, U. S. N.

Attack Upon a Superior.—It is not unlikely that the enemy would attempt to turn at 1,000 yd. and possibly attempt to increase the distance to avoid the torpedo. This, then, would probably offer a chance to fire both the torpedoes at 600 yd., or less, at the broadside of the enemy, then sheering off his quarter. This should insure the destruction of the enemy, and possibly also that of the torpedo boat; but the torpedo boat would stand the better chance of living through the engagement, and assuming that they both went down, the crew of the smaller boat has the better chance of surviving, as crews can get overboard with the small boats, gratings, etc., immediately, and the suction from the sinking boat would be less. A good many men made their escape from the *Furor* when she went down off Santiago; this was probably an average case.

These rather hazardous tactics are believed to be superior to the slow and certain destruction brought on by the cool and deliberate shots of a superior pursuer, who, free from excitement, with little risk of accident, sinks or blows up the boat at his leisure with his forward battery. For any torpedo boat or destroyer to deliberately come out and attack a superior vessel in broad daylight is mere bravado, and has proved a failure in many cases.

A recent example of such failures was the attack on the *St. Paul* by the Spanish destroyer *Terror*. The boat was promptly disabled and again turned toward the port.

Of course, every precaution should be taken to prevent these small craft from being placed in such perilous positions; but as shown in the maneuvers abroad, it is not unusual for daylight to catch them far from their home station, the prey of a passing scout. The first effort would be to escape into the nearest shoal, or port; but failing in this, a final attack would seem better than slow destruction in a vain effort to escape.

In the tactics employed a strong point to be considered is that a man will fight better and shoot straighter under the stimulus and excitement of a charge than when fleeing from a superior enemy. He has the encouragement of the offensive rôle, with the advantage of a surprise, and yet the employment of his full battery. If his pursuer be a gunboat the latter probably could employ only a very small part of his battery until he could turn his broadside; he might even reach torpedo range before the gunboat captain realized the importance of this, and turn only in time to afford a broad target for the torpedo.

In the case where seagoing torpedo boats are scouting for the fleet, especially in night formations where they represent the feelers, their duty is to let no torpedo vessel pass through their lines toward the battleships. The instructions in the Spanish war, when it was expected that the Spanish destroyers might be met, were that they must be stopped at all hazards by any boat or boats discovering them. This, of course, meant a charge, with all guns bearing that

*Prize essay read before the U. S. Naval Institute, Annapolis Md., and copyright, 1900, by R. H. Jackson, U. S. Naval Institute.

were possible. Three 6-pdrs. well manned in a charge might stand a good show in such a fight against the present battery of the destroyers as arranged abroad.

The shifting of the 1-pdr. in 100 ft. boats from aft to forward tower no one will dispute.

The selection of three 6-pdrs. is based on the following reasons:

(1) These boats being destined for sea trips of moderate length risk encounters with other large torpedo boat destroyers and small gunboats.

With this battery the chance of disabling their opponents in any of these classes might be good; with the present 1-pdr. they would be small indeed. The effect of a 6-pdr. at 2,500 yd. or under would probably suffice to wreck steering gear and machinery quite as effectually as the 12-pdr., while the probability of a hit from any gun at a greater range than 3,000 yd. from the lively platform afforded by these boats is small. Briefly, it is thought that the 6-pdr. covers the range of 1,000-3,000 yd. as well as the larger gun; while the 1-pdr. counts for but little beyond 1,000, so that it is badly outclassed by the 6-pdr.

In the matter of weight the 6-pdr. counts as about 4-1. So that in the *Morris* type the second and third 6-pdrs. would be gained at the sacrifice of the third torpedo. In the *Porter* type the same is true.

That any torpedo boat should carry a spare torpedo seems to be without reason. She is not going to have time during an engagement to place this torpedo in the tube and fire it; and after the engagement is over, if the boat is serviceable, she can return to her station for a new outfit of torpedoes, or else get them from the battleships of the fleet. Even the advantages claimed for three torpedoes over two seems scarcely to be sufficient. If the boat has on board two torpedoes, in good order ready for use, the careful delivery of two shots at a reasonably close range ought certainly to result in the destruction of the ship at which the shot is directed. If there are three or more torpedoes to be fired, it is feared that the feeling that one of them surely ought to hit because of the number of them, if only they can all be fired, would lead to less careful firing; while a desire to get in the whole number in the brief interval of the engagement would tempt the use of the first one at an uncertain or impossible range. It is the feeling of the writer that the opportunity which offered a chance for two shots properly and deliberately executed, two torpedoes would serve as well as ten.

The transfer of torpedoes from the battleships, even in moderately rough weather, could be accomplished by sending over the head, flask and after body separately boxed if necessary.

The Air Compressor.—The types that depend upon leather washers for their proper working have been found most unsatisfactory. On the two largest boats tolerable success was attained, but the other boats kept their torpedoes charged with great difficulty. An entire day and night would sometimes be consumed in an attempt to charge a single torpedo. The failures being due to burnt out and leaky washers. All of the boats of an older date than the *Talbot* need new compressors. The type on the *Talbot* and *McKenzie* has proved satisfactory. The machine is able to charge the torpedo in a reasonable time, even if one cylinder be disabled from any cause. This has been done in cases where it was thought important to charge the torpedo at once.

While the torpedo director is a simple and accurate instrument, the conditions demanding its employment on board a torpedo boat do not seem likely to arise, and it seems to be an unnecessary fitting. With the Obry gear the speed of the torpedo boat is no longer a consideration. In attempting to reckon on the speed of the enemy, an allowance such as a half a ship's length or a ship's length, as the case may be, would be as accurate as could be expected. An attempt to use the instrument at night on a torpedo boat would be absurd.

CRITICISM OF CERTAIN POINTS IN EQUIPMENT.

The allowance and outfit from this Bureau is so small that there are few points for discussion. The only important items are the compass, the electric plant, and the anchor gear.

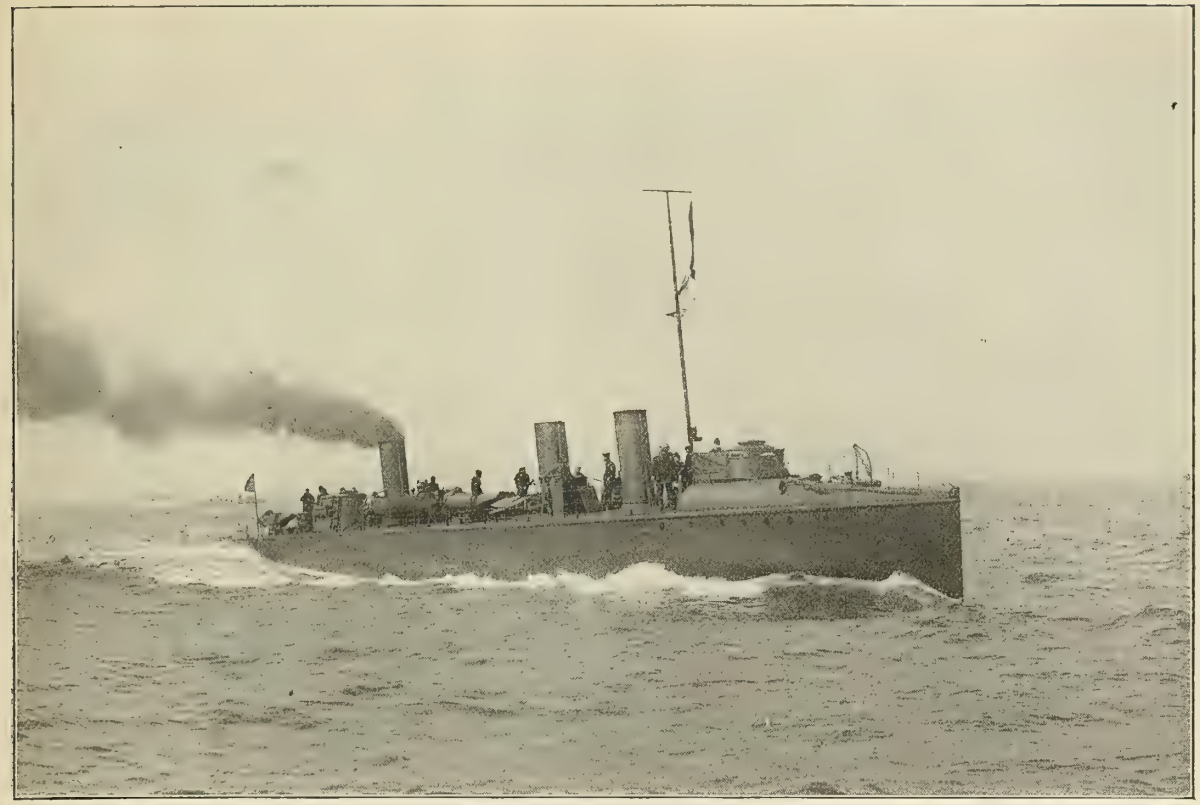
The wire anchor cables on the *Winslow* class seem to have been too light, one boat having parted three cables while at anchor at Key West. The cables had been kept well covered with vaseline, and showed no signs of deterioration. The anchor for this type also seems too light. The boats dragged often, and one anchor parted at the middle of the arm. One of these boats, anchored in five fathoms of water, used 3 1-2 in. manila hawser, slipping and buoying when getting under way, and rode out a fresh norther with this tackle. These hawsers are much used by schooners, and when care is used to prevent chafing are of great service under special conditions. The ground tackle of the *Talbot* class seems to have worked well, and the methods of hoisting the anchor by means of the steering engine is very neat, and works well, saving a second engine. In the *Porter* class the anchor gear seemed to work well, but the high bow, and light draft forward makes these boats very uneasy at their anchors, requiring the second anchor for the slightest squall.

The standard compass in the different boats seems to have been well placed and given good service. The Negus compass on the *Gwin* class is satisfactory for the rough work required.

The dynamos and the electric installation have given good service. They are needed on all boats except class R, which, however, need to be wired so that they can connect to the plant in the navy yard when at the dock. A small searchlight has been fitted at the forward conning tower of a good many boats. While it is useful for navigation, its usefulness for war service is doubtful, and the objections rather outweigh its advantages; its weight and conspicuous position are especially objectionable. Nor is the use of this light on the destroyer to be recommended. An effort to hold it upon the fleeing torpedo boat would be unsuccessful from such an unsteady platform, and the attempt to pick up a boat with it often leads to more confusion than success. This was found to be the case upon the blockade.

CRITICISM OF STEAM ENGINEERING.

All of the boilers so far employed in our torpedo craft have been of the bent tube pattern, nearly all of them differing from the Thornycroft, principally in



U. S. TWIN SCREW TORPEDO BOAT DUPONT, TRIAL DISPLACEMENT 165 TONS, SPEED ON TRIAL 28.58 KNOTS
(*Photo Copyright by Muller*)

U. S. TWIN SCREW TORPEDO BOAT MORRIS, TRIAL DISPLACEMENT 104 TONS, SPEED ON TRIAL 24 KNOTS.
(*Photo Copyright by Muller.*)

the fact that they have drowned tubes. The advantages of the two systems are so well known that it is needless to enter into discussion here. Criticism will be confined to especial points brought out by experience in working them.

Winslow Type.[1]—In general terms this boiler, instead of a single upper drum amidships, has two upper drums each over its lower drum. As originally designed, there was a pipe connecting the upper drums, with the result that at sea, with the boat rolling, one gauge glass would show full and the other empty. To overcome this objection the connection between the upper drums was abolished, resulting in making the two halves independent, or, in other words, giving two small boilers instead of one large one. To supply them with feed water the feed pipe forked in the fire room, feeding each side through a check in the upper drum. It was found almost impossible to feed the two sides equally through this forked pipe. The result was that the water was always tended badly; generally it was carried too high, with the resultant water in the cylinder, but occasionally it was lost entirely, and on one or more occasions burnt tubes to show for it. It was not that the men were green or nervous; many men were tried in this billet on the different boats, old and experienced water tenders were equally unsuccessful. Even if the water, by careful watching, can be successfully controlled, it doubles the force required in the fire room, for when using the ordinary type of boiler one experienced man tends water, gets out coal, and fires in the ordinary work of running around a station, when running at low speeds for cruising. If the boat is to make her maximum speed, the second man is needed to get out coal and to take a turn at the firing, but the water gives no trouble. Then the lower drums of this boiler were so small that only a boy could get into them, and the rolling of a tube by the force on board was impossible; moreover, the efficiency of the boy's work was always doubtful. This boiler had a blank flange on the side of the pipe leading to the safety valve; the metal used to blank off the orifice was too light, and springing slightly at the high pressures blew out the gasket and cleared the fire room on several occasions.

It is often the case, when a man is driven out of the fire room by the bursting of a pipe or bad joint, that he will be able to throw open the furnace doors but not haul the fires. If there is a small port between the fire and engine room, a hose can be played through this port from the donkey engine, and thus wet down the fire till it can be controlled. The great importance of having safety valves and boiler and engine stops accessible from the deck is generally recognized, and most of our boats are so fitted. The deck valves should always be used after the run to shut off the steam, and frequently to insure their easy working.

DISTRIBUTION AND SERVICE IN TIME OF PEACE.

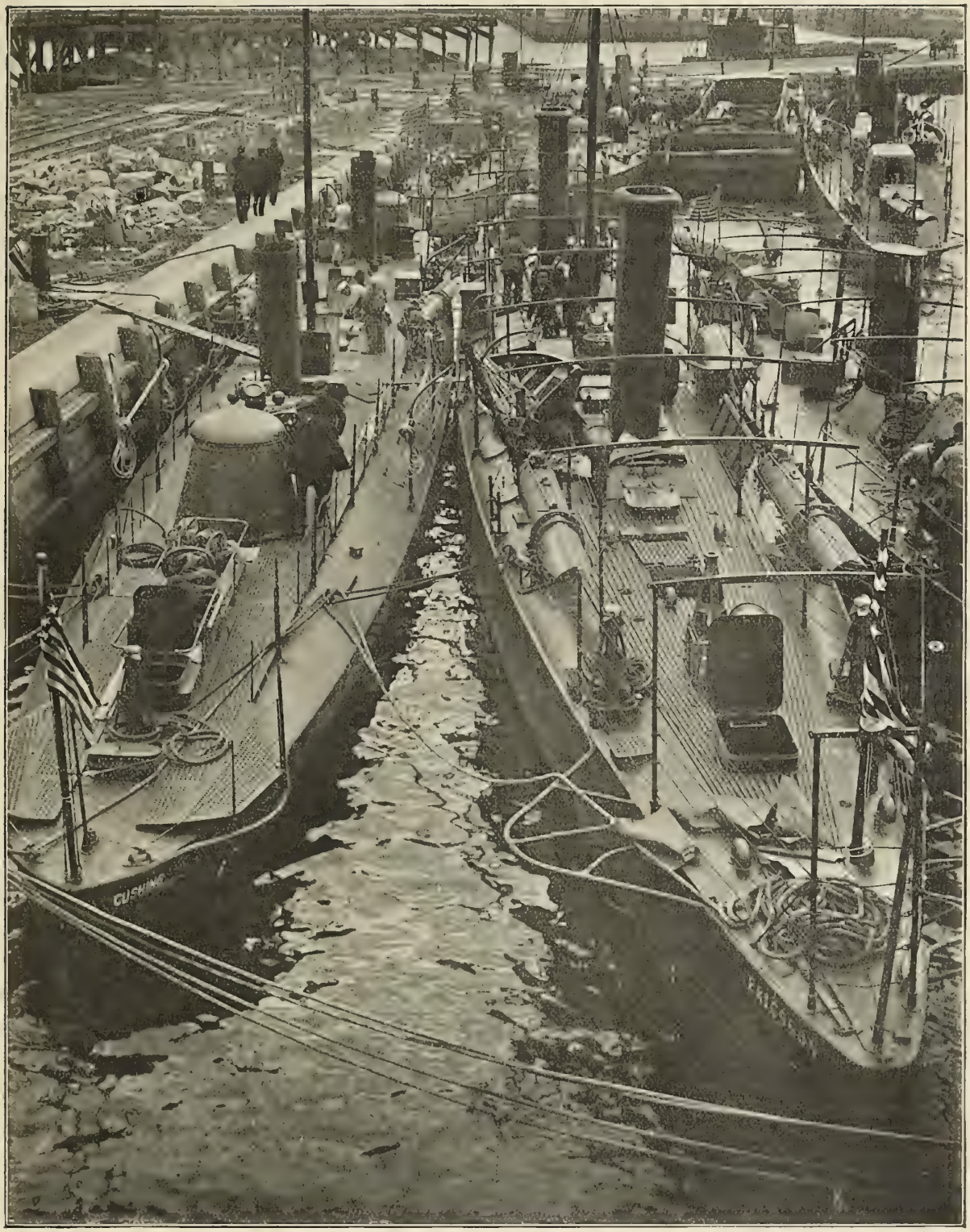
This should correspond as far as possible with that which the boat would see in time of war. Consequently the station boats of the *Talbot* class should be distributed in the neighborhood of their cruising grounds, in order to thoroughly familiarize themselves with the channels and coast in all conditions of weather and in all seasons. If possible, their crews should come from that district, and they should be allowed to remain there the greater part of the year. During a certain season they should be withdrawn to a more favorable climate for torpedo practice, manœuvers with the fleet, or such employment as might be demanded by the exigencies of the service. The assembly of them all at Newport in the summer would give a fine opportunity for concerted action with the fleet. Boats belonging to the district north of Philadelphia would do well to winter not further north than the Chesapeake Bay.

The larger boats designed to act with the squadron should conform in a general way with the movements of the large ships; that is, to visit our southern ports in the winter, and then assemble on the New England coast for combined practice in the summer.

The recommendations of the different commanding officers at the end of the war no doubt gave a very good idea of the needs of the boats as regards the complements of the crews. In general terms it was more men and higher ratings. It is difficult to see how larger crews can be accommodated in the crew space allowed. The only remedy is to avoid keeping crews on arduous duty such long periods at a stretch. Then, too, it must be remembered that most of these boats in the war did service calling for work beyond the scope of the boat and the crews as well. For work extending only over a short period their crews were sufficient. In regard to the rating, it is, of course, impossible to have each man a chief machinist or a chief gunner's mate; but the rate on deck should not be less than a seaman, and that in the engineer's force not lower than firemen, first class. In considering the fitness of a man for a torpedo boat, it is important to consider his liability to seasickness. Very good men on larger ships sometimes prove to be of little value when the boat gets caught in a gale—a time when a man can be illy spared from his work. Men detailed for this service must be moderately young, of good habits, not liable to severe seasickness, intelligent and reliable. Any severe punishment inflicted is sure to react on the rest of the crew as well, since it brings extra duty on all of them. The opportunities for obtaining liquor are greatly increased, as compared with the condition on board a large ship. The regulations now require that a man who has served on a torpedo boat be marked as to his special fitness for that duty. By this means a corps of men specially fitted for this work can be obtained by the department, so that when it is desired to bring the crew of a boat up to its full complement, the seamen can be drafted from other duty to these vessels.

[1]The Winslow was fitted with Mosher water tube boilers. Ed. M. E.

S.S. Northeastern.—The steamship *Northeastern* was launched last month from the yard of the Chicago Shipbuilding Co. at South Chicago, Ill. The *Northeastern* is the third vessel built by the Chicago Co. for the Northwestern Steamship Co.



U. S. TORPEDO BOATS IN WET DOCK AT BROOKLYN NAVY YARD, U. S. SS. CUSHING AND ERICSSON IN THE FOREGROUND.

OCEAN FREIGHTERS ALASKAN AND ARIZONIAN BUILDING AT UNION IRON WORKS.

Among the large ocean freight steamships which the revival in shipping has caused to be constructed in American shipyards, two very interesting ships are under construction at the Union Iron Works, San Francisco, Cal. These vessels are to be named the *Alaskan* and the *Arizonian*, and are for the American-Hawaiian Steamship Co., to trade between New York, San Francisco and Honolulu. These are sister ships, classed 100A under Lloyds three deck rules, with complete shelter deck. They will be fitted with twin screws, and are of the following dimensions: Length between perpendiculars, 471 ft. 1 in.; beam moulded, 57 ft.; depth moulded to upper deck, 35 ft. These vessels were designed to carry 11,000 tons on 27 ft. draft.

The *Alaskan* and the *Arizonian* are intended exclusively for freight carrying, and have been so designed. They will be very strong vessels with large stowage capacity and power sufficient to drive them at the rate of about 10 knots. Each has nine separate water tight compartments, the 'thwartship steel bulkheads extending from the top of the double bottom to the under side of the shelter deck. The double bottom is carried the entire length, and the vessels are fitted with deep frames, spaced 26 in. throughout. The three decks are of steel, and in the hold forward there is an orlop deck below the main deck. Each will have two straight masts, and one straight stack, the masts being fitted with booms for handling cargo, and also rigged to carry steadying sails. In addition to the masts there will be steel posts carrying cargo handling gear connected to independent winches, so that all of the six hatches will be readily worked.

Accommodations for the captain and officers are located in houses on the shelter deck amidships. These will be fitted up in the most modern style, with complete lighting and sanitary arrangements. At the extreme ends on the upper deck there will be quarters arranged for the firemen and sailors.

The ships are fitted with straight keels, with a well in the stern frame. The propeller shafts will be carried in a spectacle frame, the plating covering the shafts to the propeller hubs. There is a deep tank fitted forward of the 'thwartship coal bunker, and also the usual fore and aft peaks, and ballast tanks at the after end, the total water capacity being about 3,500 tons. For handling the vessels, each will have a heavy steam capstan at both ends, and at the fore end a steam windlass for raising the stockless anchors.

In the accompanying plans and cross section, the structural details are given, together with the capacities of the various compartments.

The machinery equipment will be of the most modern design, with a view especially to economy of operation. Engines of the four-cylinder, quadruple expansion type will be fitted, with cylinders 21 1-2 in., 28 in., 38 in., and 60 in. dia. and 36 in. stroke. They will turn up 100 revolutions, and each engine will develop 1,300 (calculated) I. H. P. The engines are alike, port and starboard, and the dimensions of one will answer for both. The bed plate is of cast iron, box type, in one piece 24 ft. 9 in. at the base. Both the H. P. and 1st I. P. cylinders are connected in one section entirely free from the 2d I. P. and L. P. cylinders, which latter form the after end of the engine. From the center of the crank shaft to the center of the piston stroke is 12 ft. 9 in. Opposite the 2d I. P. and L. P. cylinders the condenser is located, making also a support for the back columns and guides. Supported by the back of the condenser is the air pump, directly connected to the 2d I. P. crosshead. This is 20 in. dia. and 15 in. stroke and is single acting.

Cast iron is used for the four front as well as the two forward back columns. Bethlehem fluid compressed steel is used for the crank shaft, which is 10 3-4 in. dia. The

CARGO CAPACITY.		
	CU. FT.	TONS 40 CU. FT.
HOLDS #1	33350	833
" #2	93180	2329
" #3	103138	2578
" #4	42498	1062
ORLOP DECK	24000	600
DEEP TANK	19200	480
'TWEEN DECKS #1	27360	684
" " #2	53760	1344
" " #3	44160	1104
" " #4	27200	680
'TWEEN DECKS UPPER #1	17280	432
" " " #2	38608	965
" " " #3	32000	801
" " " #4	18240	456
TOTAL	573974	14348

BUNKER CAPACITY.		
	CU. FT.	TONS 42 CU. FT.
POCKETS S. & P.	1638	39
HOLD	30110	716.9
'TWEEN DECKS, SIDE	18464	439.6
" " FOR'D	13840	329.5
" " UPPER	22488	535.4
TOTAL	86540	2058.24

STORES.		
	CU. FT.	TONS 40 CU. FT.
STORE ROOM MAIN DK. FOR'D	2660	66.5
" " " " AFT	3050	76.
" " ORLOP DECK	1900	47.5
REFRIGERATOR	1060	26.5
VEGETABLES	657	16.5
TOTAL	9327	233.0

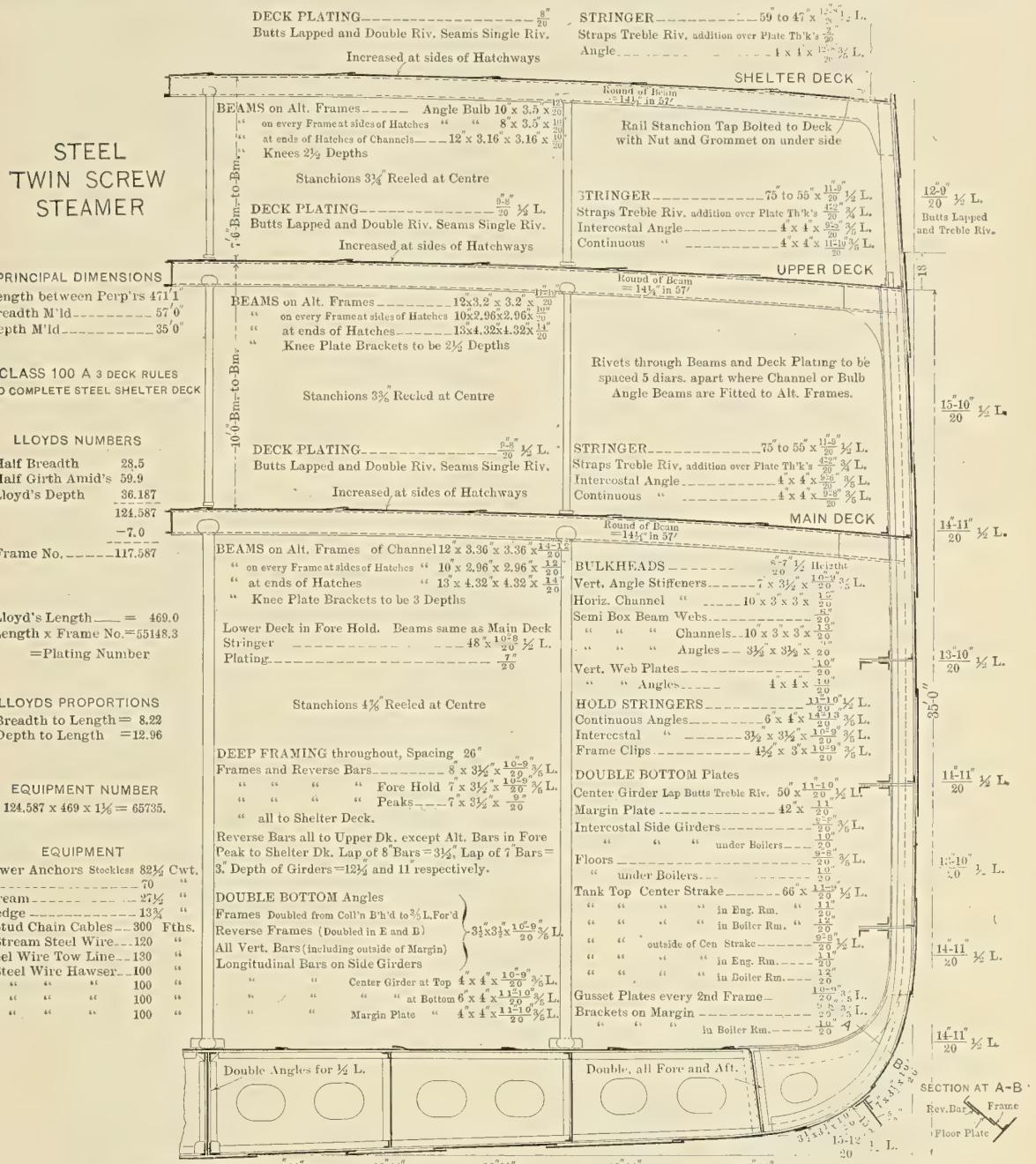
WATER BALLAST.		
	CU. FT.	TONS 35 CU. FT.
FORE PEAK	4480	128
DOUBLE BOTTOM #1	9200	262
" " #2	14560	416
" " #3	3910	111
" " #4	5152	147
" " #5	7360	210
" " #6	7520	214
" " #7	16176	462
" " #8	5845	167
AFTER PEAK	6150	175
DEEP TANK	32400	925
AFTER TANKS	13059	372
TOTAL	125812	3589

SEE PLANS ON PAGES 106 AND 107.

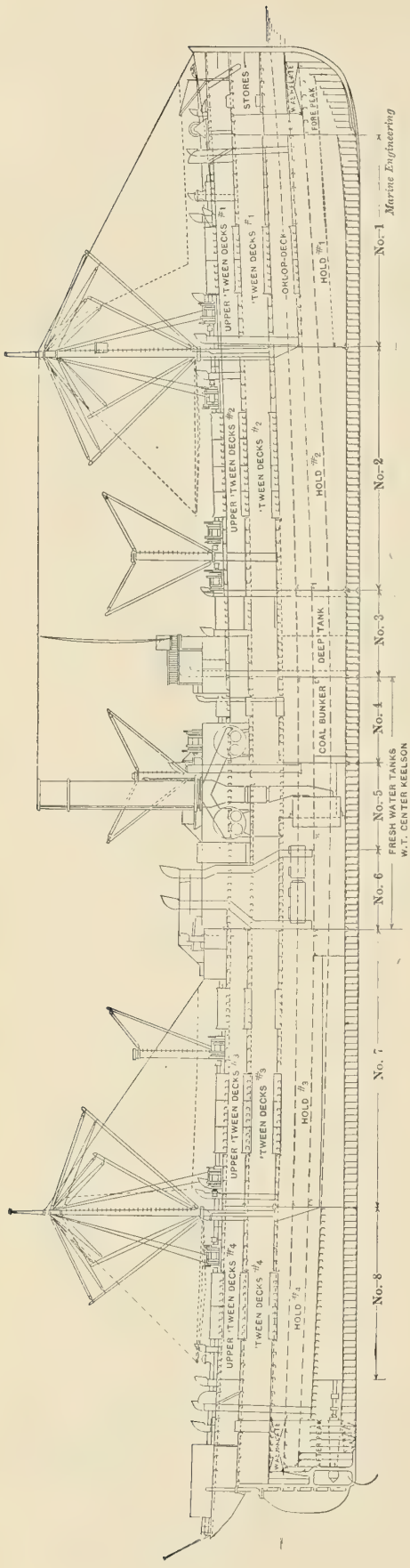
sequence of cranks is: L. P., 2d I. P., 1st I. P. and H. P. The intermediate shaft is 10 1-2 in dia., and the tail shaft partly 11 in. and partly 12 in. dia. Diameter of the connecting rod is 5 1-2 in. at the top end and [illegible]gine is of the direct type, with cylinder 9 in. dia. and 6 1-8 in. at the crank. All piston rods are 5 in. dia., [illegible]16 in. stroke.

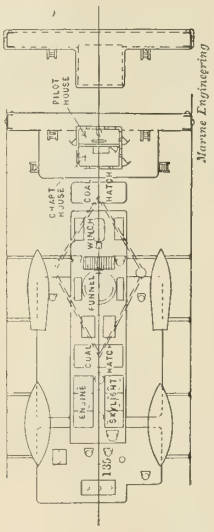
and the pistons are of cast iron and are of the flat type.

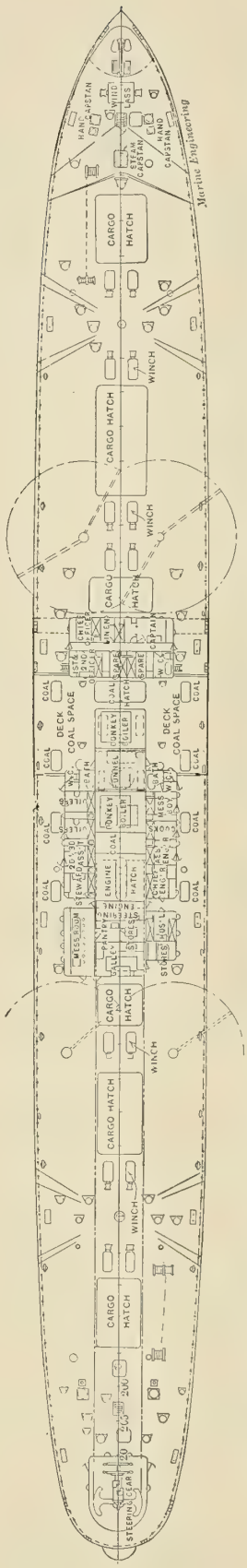
A turning engine 4 in. and 4 in. by 4 in. is located on the front side of the condenser, and the reversing en-


STEEL TWIN SCREW STEAMER
PRINCIPAL DIMENSIONS
Length between Perp'rs 471'1"
Breadth M'ld 57'0"
Depth M'ld 35'0"
CLASS 100 A 3 DECK RULES AND COMPLETE STEEL SHELTER DECK
LLOYDS NUMBERS
Half Breadth 28.5
Half Girth Amid's 59.9
Lloyd's Depth 36.187
124.587
−7.0
Frame No. 117.587
Lloyd's Length = 469.0
Length x Frame No.=55148.3
=Plating Number
LLOYDS PROPORTIONS
Breadth to Length = 8.22
Depth to Length =12.96
EQUIPMENT NUMBER
124.587 x 469 x 1⅛ = 65735.
EQUIPMENT
2 Bower Anchors Stockless 82½ Cwt.
1 70
1 Stream 27½
1 Kedge 13¾
2½" Stud Chain Cables 300 Fths.
5¼ Stream Steel Wire 120
6" Steel Wire Tow Line 130
2⅝" Steel Wire Hawser 100
2⅝" 100
2⅝" 100
2⅝" 100
DECK PLATING 9/20" Butts Lapped and Double Riv. Seams Single Riv.
Increased at sides of Hatchways
STRINGER 59" to 47" x 12/20" ½ L.
Straps Treble Riv., addition over Plate Th'k's 2/20"
Angle 4 x 4 x 12/20" ⅜ L.
SHELTER DECK
Round of Beam =14½" in 57'
BEAMS on Alt. Frames Angle Bulb 10" x 3.5" x 12/20"
" on every Frame at sides of Hatches " " 8" x 3.5" x 10/20"
" at ends of Hatches of Channels 12" x 3.16" x 3.16" x 10/20"
" Knees 2½ Depths
Stanchions 3¼" Reeled at Centre
Rail Stanchion Tap Bolted to Deck with Nut and Grommet on under side
DECK PLATING 9-8/20" ½ L.
Butts Lapped and Double Riv. Seams Single Riv.
Increased at sides of Hatchways
STRINGER 75" to 55" x 11-9/20" ½ L.
Straps Treble Riv. addition over Plate Th'k's 15-2/20" ⅜ L.
Intercostal Angle 4 x 4 x 9-8/20" ⅜ L.
Continuous " 4 x 4 x 11-10/20" ⅜ L.
12-9/20" ½ L. Butts Lapped and Treble Riv.
UPPER DECK
Round of Beam =14¼" in 57'
BEAMS on Alt. Frames 12 x 3.2 x 3.2 x 12/20"
" on every Frame at sides of Hatches 10 x 2.96 x 2.96 x 10/20"
" at ends of Hatches 13 x 4.32 x 4.32 x 14/20"
" Knee Plate Brackets to be 2½ Depths
Stanchions 3⅜" Reeled at Centre
Rivets through Beams and Deck Plating to be spaced 5 diars. apart where Channel or Bulb Angle Beams are Fitted to Alt. Frames.
DECK PLATING 9-8/20" ½ L.
Butts Lapped and Double Riv. Seams Single Riv.
Increased at sides of Hatchways
STRINGER 75" to 55" x 11-9/20" ½ L.
Straps Treble Riv. addition over Plate Th'k's 15-2/20" ⅜ L.
Intercostal Angle 4 x 4 x 9-8/20" ⅜ L.
Continuous " 4 x 4 x 9-8/20" ⅜ L.
15-10/20" ½ L.
MAIN DECK
Round of Beam =14½" in 57'
BEAMS on Alt. Frames of Channel 12 x 3.36 x 3.36 x 14-3-2/20"
" on every Frame at sides of Hatches " 10 x 2.96 x 2.96 x 12/20"
" at ends of Hatches " 13 x 4.32 x 4.32 x 14/20"
" Knee Plate Brackets to be 3 Depths
Lower Deck in Fore Hold. Beams same as Main Deck
Stringer 48 x 10-8/20" ½ L.
Plating 7/20"
Stanchions 4⅜" Reeled at Centre
DEEP FRAMING throughout, Spacing 26"
Frames and Reverse Bars 8 x 3½ x 10-9/20" ⅜ L.
" " " " Fore Hold 7 x 3½ x 10-9/20" ⅜ L.
" " " " Peaks 7 x 3½ x 9/20"
" all to Shelter Deck.
Reverse Bars all to Upper Dk. except Alt. Bars in Fore Peak to Shelter Dk. Lap of 8" Bars = 3½", Lap of 7" Bars = 3" Depth of Girders = 12½ and 11" respectively.
DOUBLE BOTTOM Angles
Frames Doubled from Coll'n B'h'd to 3/5 L. For'd
Reverse Frames (Doubled in E and B)
All Vert. Bars (including outside of Margin)
Longitudinal Bars on Side Girders
3½" x 3½" x 10-9/20" ⅜ L.
" " " Center Girder at Top 4 x 4 x 10-9/20" ⅜ L.
" " " " " at Bottom 6" x 4" x 11-10/20" ⅜ L.
" " " Margin Plate " 4 x 4 x 11-10/20" ⅜ L.
BULKHEADS 6-7/20" ½ Height
Vert. Angle Stiffeners 7 x 3½ x 10-9/20" ⅜ L.
Horiz. Channel " 10 x 3 x 3 x 15/20"
Semi Box Beam Webs 5/20"
" " " Channels 10 x 3 x 3 x 13/20"
" " " Angles 3½ x 3½ x 10/20"
Vert. Web Plates 10/20"
" " Angles 4 x 4 x 10/20"
HOLD STRINGERS 11-10/20" ½ L.
Continuous Angles 6 x 4 x 14-13/20" ⅜ L.
Intercostal " 3½ x 3½ x 10-9/20" ⅜ L.
Frame Clips 4½ x 3 x 10-9/20" ⅜ L.
DOUBLE BOTTOM Plates
Center Girder Lap Butts Treble Riv. 50" x 11-10/20" ½ L.
Margin Plate 42" x 11/20"
Intercostal Side Girders 5-5/20" ⅜ L.
" " " under Boilers 10/20"
Floors 9-8/20" ⅜ L.
" under Boilers 10/20"
Tank Top Center Strake 66" x 11-9/20" ½ L.
" " " " in Eng. Rm. " 11/20"
" " " " in Boiler Rm. " 12/20"
" " outside of Cen Strake 9-8/20" ½ L.
" " " in Eng. Rm. 11/20"
" " " in Boiler Rm. 12/20"
Gusset Plates every 2nd Frame 10-9/20" ⅜ L.
Brackets on Margin 9-8/20" ⅜ L.
" " " in Boiler Rm. 10/20"
14-11/20" ½ L.
Double Angles for ½ L.
Double, all Fore and Aft.
SECTION AT A-B
Rev. Bar
Frame
Floor Plate
15-12/20" ½ L.
Marine Engineering
15-14/20" ½ L.
13-11/20" ½ L. Aft. and Coll'n B'h'd For'd
12-10/20" ½ L. Aft. and Coll'n B'h'd For'd
13-11/20" ½ L.
14-11/20" ½ L.
Keel Plate 48" x 20-15/20" ⅜ L.
Doubled with 15/20" ½ L.
Straps Treble Riv. with
Addition over Plate Th'k's of 4-2/20" ¾ L.
Shelter Deck Sheerstrake 14-9/20" ½ L.
Double Straps Treble Riv.
Outside Straps 10-7/20" ½ L.
Inside " 9-6/20" ½ L.
Sheerstrake 46" x 18-15/20" ½ L.
Double Straps Treble Riv.
Outside Straps 13-10/20" ½ L.
Inside " 11-6/20" ½ L.
Stem 12" x 3⅜"
Stern Post 13" x 8"
Rudder Head 10⅜"
Rudder Heel 5¼"
SHELL BUTTS from Garboard to Strake under Upper Deck. Sheerstrake inclusive to be Lapped and Quadriple Riveted for ½ L. Amid. To be Treble Riveted at ends, except where the outside Strakes exceed 46" and inside Strakes 54" when they will be Quadriple.
Seams of Shell all Double Riveted.
Beam
Bracket
SKETCH SHOWING BEAM CONNECTED TO FRAME.
SKETCH SHOWING MODIFICATION OF UPPER HOLD STRINGER IN WAY OF LOWER DK. IN FORE HOLD.

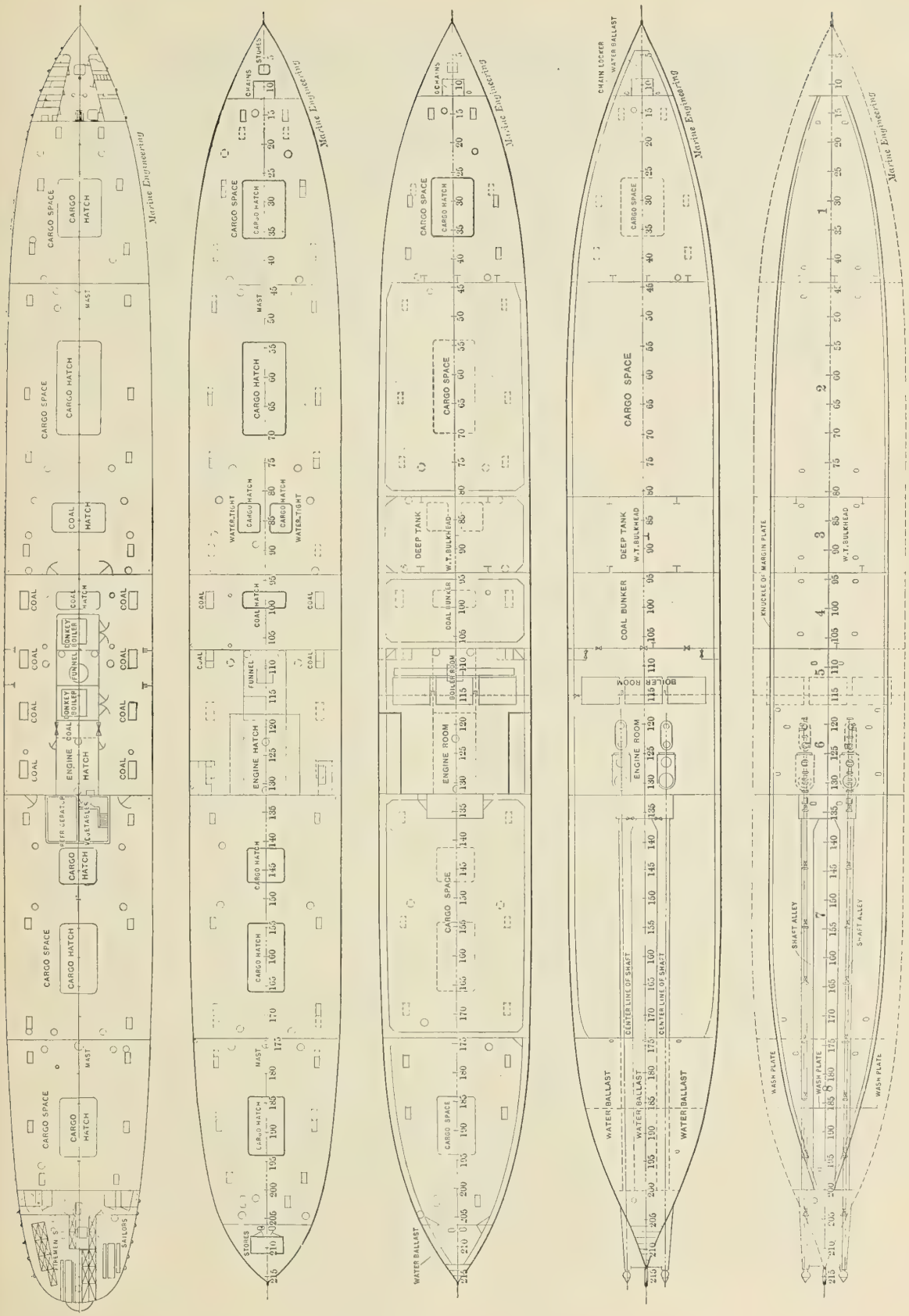
CROSS SECTION AND CONSTRUCTION DATA OF SS. "ALASKAN AND ARIZONIAN FOR AMERICAN-HAWAIIAN S.S. CO.







PLANS OF THE TWIN SCREW FREIGHT STEAMSHIPS ALASKAN AND ARIZONIAN BUILDING AT UNION IRON WORKS, SAN FRANCISCO, FOR THE AMERICAN-HAWAIIAN STEAMSHIP CO.



PLANS OF THE TWIN SCREW FREIGHT STEAMSHIPS ALASKAN AND ARIZONIAN BUILDING AT UNION IRON WORKS, SAN FRANCISCO, FOR THE AMERICAN-HAWAIIAN STEAMSHIP CO.

Stephenson link motion is used throughout, the H. P. and 1st I. P. cylinders having piston valves 12 3-4 in. dia., and the 2d I. P. and L. P. cylinders slide valves. All piston and valve rods are packed with metallic packing. Cast iron is used for the guides, which are of the slipper type, and the crossheads are cast steel.

The main steam pipe is 6 in. dia. The throttle valve is of the combination stop and butterfly type, with a small by-pass. On one end of the extended air pump crosshead is a bilge pump and on the other a sanitary pump attached. Cooling surface in the condenser is 2,600 sq. ft.

There are three single ended main boilers, each 14 ft. 3 in. dia. and 10 ft. 3 in. long, built for a working pressure of 215 lb. per sq. in. There are four 34 in. furnaces in each, with 4 ft. 6 in. bars, and 426 tubes, each 2 1-4 in. dia. by 78 in. long. The grate area is 54 sq. ft., and the heating surface 2,040 sq. ft.

There are also two auxiliary boilers, each 10 ft. dia. and 10 ft. 6 in. long. They have two furnaces 36 in. dia., with bars 4 ft. 3 in. and 114 tubes each 3 1-4 in. by 6 ft. 4 1-4 in. The grate area is 255 sq. ft., the heating surface 772 sq. ft. and the working pressure 90 lb. per sq. in.

Howden draft is fitted for the main boilers, two 6 ft. blowers being driven by compound engines, 5 in. and 8 in. dia. by 6 in. stroke.

Other auxiliary machinery includes: independent circulating pumps, 10 in. suction and discharge, driven by a 5 in. and 9 in. by 6 in. compound engine; one independent Dow patent vertical compound duplex main feed pump with 6 in. and 12 in. steam ends and 5 in. water end and 10 in. stroke. One auxiliary main boiler feed pump of like capacity. One auxiliary boiler feed pump, of vertical duplex type, 7 1-2 in. and 4 1-2 in. by 10 in. Two ballast pumps, vertical duplex, 7 1-2 in. and 8 1-2 in. by 10 in. Two vertical duplex fire and bilge pumps, 9 in. and 6 in. by 10 in. A horizontal combination feed and brine pump, 3 in. by 2 1-4 in. feed, and 3 in. by 1 3-4 in. brine. Two evaporators with 30 tons capacity, for both, in 24 hours. One exhaust feed heater, one ash hoist, 3 1-2 in. and 3 1-2 in. by 6 in., of the builder's steam driven standard type. One 8 K. W. direct connected generating set.

In the deck department there are: two steam capstans, 6 in. and 6 in. by 8 in.; one steering engine, 8 in. and 8 in. by 8 in.; one windlass, 10 in. and 10 in. by 16 in., with 2 1-2 in. cable; fifteen steam winches for handling cargo.

The propellers are of the built up type, with cast iron hubs and cast steel blades. Their dia. is 13 ft. and pitch 12 ft. 6 in.

In every respect these vessels will represent the most advanced practice in the construction of ocean going freighters, and they will be a most important addition to the American merchant marine.

Sch. Edith G. Folwell.—The *Edith G. Folwell* was launched last month from the yard of the New England Co., Bath, Me., recently. The vessel was christened by Mrs. George L. Kelsey, of Clinton, Conn. The *Folwell* is of these dimensions: Length, 196.9 ft.; beam, 40.4 ft.; depth, 18.4 ft.; gross tonnage, 1,263 tons and carrying capacity, 1,850 tons.

PHILIP HICHBORN, U. S. N.

On March 4 Rear Admiral Philip Hichborn, chief constructor of the United States Navy, will retire on account of the age limit. His connection with the Navy dates back from almost boyhood, and the intervening years have been occupied in earnest successful work. In tribute to his qualities one who has been professionally very closely associated with the Chief Constructor says: "His advancement has been earned through strict application to whatever duty he was set to perform. Ambitious to excel, he has received the recognition of his labors. Always kind, sympathetic, and considerate in his treatment of subordinates; a thorough mechanic, and master of his profession, he has the confidence and respect of his men who have invariably acknowledged their appreciation of his generous consideration by strict obedience to orders and faithful performance of duty. Without requesting, and much less demanding it, he has at all times received the full measure of each employe's labor, which has gained for him that enviable and merited reputation for excellent management and executive ability, and which has been the prime cause of his success." In the true sense of the term he is a self made man, and a brief sketch of his career will be of special interest, especially to the junior members of the profession:

Philip Hichborn was born in Charlestown, Mass., in the year 1839. His father was a resident of Boston, and it was in the public schools of that city that the future chief constructor received his early education. Soon after graduation he was appointed assistant secretary to Admiral F. H. Gregory, U. S. N., then commandant of the Boston Navy Yard. In this yard Philip Hichborn was subsequently indentured to the Government as shipwright apprentice. While an apprentice he attended night classes at a local academy and there again showed an aptitude for study, graduating with honors. When the term of apprenticeship expired, the then Secretary of the Navy, Isaac Toucy, ordered the youth to a course of theoretical training in ship design and calculations, and for two years he was under the tuition of Professor Molle.

In August, 1861, Mr. Hichborn left Boston, as carpenter of the clipper ship *Dashing Wave,* on a trip to the Pacific coast. This voyage occupied 150 days, giving the young shipbuilder a valuable opportunity of witnessing the behavior of a vessel at sea in various conditions of weather. For a brief time on the coast he was in the employment of merchant steamship companies, and then re-entered the Government service at the Mare Island yard as a journeyman shipwright. His training had been so thorough, and his application so dilligent that promotion came rapidly. Promotion to the place of timber inspector was followed by advancement to draftsman, quarterman, shipwright, and master shipwright, in turn. Thus, in the year 1862, while yet a youth of 23, he was in responsible charge of construction. Sometime afterward he was tendered the place of assistant naval constructor, but for financial reasons did not accept it—the salary for that work was less than that of his position at the time. In time, however, the master shipwright realized that further advancement lay in his becoming a member of the construction corps, and after

REAR ADMIRAL PHILIP HICHBORN, CHIEF CONSTRUCTOR UNITED STATES NAVY, RETIRES MARCH 4, 1901.

passing a severe examination he was appointed an assistant naval constructor in 1869.

In the following year Mr. Hichborn was ordered back east, to the Portsmouth Navy Yard, New Hampshire, or just ten years after his re-entry into the Government service on the Pacific coast. During that time his personal qualities had been recognized by a wide circle of friends in naval life and outside, and his departure for the east was made the occasion of a public festivity by the residents of Vallejo.

While at the Portsmouth yard, Mr. Hichborn was concerned with the construction of the U. S. Ss. *Marion, Enterprise* and *Essex,* and after five years at this station he passed a competitive examination with high honors, and received the rank of naval constructor.

It was always characteristic of Constructor Hichborn that he would never send anyone to carry out orders that he was not prepared to carry out himself. An instance of this occurred in 1875, when the *Ticonderoga* arrived at the Navy Yard with several cases of yellow fever on board. Under orders from the Department, Naval Constructor Hichborn submitted the vessel to a thorough cleaning process to destroy all germs of disease. This work he superintended personally, and as a result was taken ill and confined to his room for several months.

In December, 1875, he reported for duty at Philadelphia, and assisted very materially in straightening out the confusion incident to moving the tools, material, etc., from the "old yard" to that of the "new," then located at League Island. At this time he also superintended the rebuilding and fitting out of the "old" *Constitution,* which was to carry goods to the Paris Exposition.

In 1880, when Congress awoke from its legarthy, determined to reorganize the Navy and no longer be the "laughing stock of the world," Naval Constructor Hichborn was selected by Secretary Hunt to serve as a member of the first Naval Advisory Board. In addition to this and his regular duties at the navy yard he had in charge the superintendence of construction and completion of the monitors *Terror, Amphitrite* and *Puritan,* and it is due to him that two of these vessels were converted from double-turreted monitors of doubtful utility into double barbette turreted coast defense vessels of a very formidable type. These highly efficient barbette-turrets, familiarly styled "Hichborn turrets," were unanimously approved by the board of bureau chiefs, and have since been improved and perfected and become a part of the construction of every turreted vessel of the Navy.

In 1884 the need of an expert to go abroad and investigate naval progress in Europe, resulted in the selection by Secretary Chandler of Naval Constructor Hichborn, his knowledge and experience specially fitting him for that duty. How well he acquitted himself of this task, and the value of his Report on European Dockyards, is attested by the two editions Congress found necessary to authorize. On his return from Europe he was detached from duty at the navy yard, League Island, and ordered to the Navy Department, Washington, D. C., as Assistant Chief of the Bureau of Construction and Repair, and concurrently to the navy yard, Washington, as Naval Constructor at that station, in conjunction with duties at the navy yard and at the Bureau of Construction and Repair. At all times prominently associated with all matters affecting the designing and construction of our naval vessels, he was, while acting in these dual capacities, also a member of several boards, including the Board of Inspection and Survey, and the Board on Life Boats. While a member of the latter board, he gave especial attention to life saving appliances, and a careful consideration of this subject resulted in the invention of the "Franklin Life Buoy," which has received world wide recognition.

On July 12, 1893, Naval Constructor Philip Hichborn was appointed by the President of the United States to the highest position within the gift of the Construction Corps of the Navy, that of Chief Constructor and Chief of the Bureau of Construction and Repair, with the relative rank of Commodore. Twice has he been appointed to that office, and the eight years of his occupancy have resulted in great credit to the Navy. During that period the number of our ships has been greatly increased, and their pre-eminence in point of all 'round efficiency is in no small measure due to the skill and guidance of the Chief Constructor.

One of the reforms which Naval Constructor Hichborn carried out and with which his name will always be associated was the standardization of ship's boats. In this connection the recent publication of his masterly work on this subject will be recalled, a work that has raised the small boat from the haphazard sphere of the rule of thumb mechanic to the dignity of the scientifically designed vessel. In actual service, the models adopted have proven their excellence, notably in the case of international crew races which frequently occur on foreign stations.

Other features of construction of which he has been an earnest advocate are the use of inclined armor, balanced turrets, sheathing for hulls, fireproof wood, electrical appliances, submarine boats, and the change in the caliber of large guns from 13 in. to 12 in. He has always been an advocate of ships which shall be not merely fighting machines, but desirable habitations for those who live afloat, a desideratum frequently lost sight of by the naval architect and engineer who lives ashore.

Mr. Hichborn has been for a number of years a member of the Institute of Naval Architects of England, and was a few years ago elected an honorary life member of the organization, a special distinction; also of the Naval Institute of Annapolis, and one of the Vice Presidents of the Society of Naval Architects and Marine Engineers of the United States since the organization of that society. He has devoted much time to literary work, chiefly upon subjects of a professional nature, and his periodical contributions to the latter society are among the most valuable papers in its transactions. Among other organizations with which he is associated are the Freemasons, Scottish Rite, in which he has attained the thirty-second degree, and the Sons of the American Revolution. To the latter he was eligible as a direct descendant of an old Colonial family of unquestioned patriotism, one member of which, Deborah Hichborn, was the mother of Paul Revere, and of a stock that later became one of the foremost of the renowned shipbuilding and seafaring families of New England. In November, 1875, he was united in marriage to Miss

Jennie M. Franklin, of Vermont. To the charming disposition of his estimable wife and the complete domestic happiness that has always existed Mr. Hichborn owes much for the continued success in his professional career.

Foreign-Built American Owned Yachts.

In a letter addressed to the Collector of Customs at the port of New York, the Bureau of Navigation outlines the procedure to be adopted in dealing with foreign built and American owned yachts. This letter was in response to an inquiry made of the United States Treasury Department in the case of the yacht *Lady Evelyn*, and it explicitly states the regulations as to the entries, clearances, payment of tonnage tax, light money, oaths as to ownership, etc. Following is the letter:

TREASURY DEPARTMENT,
BUREAU OF NAVIGATION,
WASHINGTON, D. C.

SIR: This office is in receipt of your letter relating to the British built yacht *Lady Evelyn*, and suggesting that regulations regarding such vessels be promulgated to insure uniformity of practice.

The vessel was purchased by an American citizen in 1892, is stated to have since remained the property of American citizens, having been purchased by David Dunlop, Jr., September 18, 1900, and does not belong to any regularly organized yacht club of a foreign nation.

1. Such vessels must be entered and cleared at each port in the United States under the laws governing the entries and clearances at the custom-house of vessels not of the United States.

2. On entry from a foreign port or place, such vessels must pay alien tonnage tax of 50 cents per ton.

3. On entry from a foreign port or place, vessels from which are not exempt from tax under Presidential proclamation, such yachts must pay tonnage tax, in addition to alien tax, of 6 cents per ton or 3 cents per ton, as provided for by section 11 of the act of June 19, 1886, and act of February 5, 1897, according to the port or place from which the yacht is entered.

4. On entry from any foreign port, oath must be made before the collector of customs as prescribed by section 4226, Revised Statutes, or light money must be exacted.

5. Such vessels, although belonging to a regularly organized yacht club of a foreign nation extending privileges to yachts of the United States, do not have the privilege of "entering or leaving any port of the United States without entering or clearing at the custom house thereof, or paying tonnage tax," if owned, chartered, or used by a citizen of the United States, unless such ownership or charter was acquired prior to February, 5, 1897.

6. Every such yacht, on her return to the United States from a foreign country, must make due entry at the custom house of the port at which, on such return, she shall arrive. Respectfully,

E. T. CHAMBERLAIN,
Commissioner.

Collector of Customs, New York, N. Y.

SUBMARINE BOATS — FROM THE EARLIEST RECORDS DOWN TO THE PRESENT.*—VI.

BY CARL BUSLEY.

CHAPTER XXV.

Zédé's "Gymnote," 1889.—At the same time that Minister Aube gave Goubet the order for his boat, he also placed an order with "Société des Forges et Chantiers de la Mediterranée" for a boat designed by the former naval engineer, Zédé, according to the ideas of Dupuy de Lôme, and which was named the *Gymnote* (Fig. 57). It was built at Mourillon, by Toulon, under the supervision of Constructor Romazotté. It was launched in the fall of 1888, and during 1889 it was given the most thorough trials. The electrical equipment was designed by Krebs, the captain of the balloon service. The *Gymnote* is 56 1-2 ft. long, 6 ft. maximum diameter, and displaces 30 tons of water. It is fitted with an ordinary rudder, and two horizontal rudders aft to be used when sailing beneath the surface. The 52 H. P. electric motor drives the boat at the rate of 9 to 10 knots. The motor weighs 2 tons and takes its current from 540 storage cells, which have a total weight of 9 1-2 tons. The forward and after ends of the boat are used for water ballast, and are emptied or filled by an electrically driven pump. The crew of the *Gymnote* consists of four to five men, including the commander. The enclosed air would last for several hours for five men, and therefore no provision was made for artificial renewal of the air. The compressed air reservoir which was fitted was intended solely for launching the torpedoes. Zédé's boat, as well as Goubet's, was fitted with a tube which projected above the surface of the water, the upper end of which held a small mirror about 1 in. dia. set at an angle of 45 deg. to the horizon and movable about its vertical axis so that the whole horizon could be seen from the inside of the boat, provided, of course, that the waves or spray did not destroy the reflecting power of the mirrors. The *Gymnote*, similar to the other boats, does not possess a very good fore and aft stability when submerged. When, by outside influence, the bow becomes depressed it shoots ahead at the same angle and quite a time elapses before it obeys the horizontal rudders. When at last these get control, and guide her upward, the same performance repeats itself, so that she is constantly pitching to every wave, and that in a very aggravating manner. With a speed of 10 knots she is said to have a radius of action of 45 miles, and with six knots this will be increased to 120 miles. When sailing several feet or more beneath the surface the observation tube, of course, is useless, and the crew must then guide the boat either by compass or by means of a gyroscope, the same as fitted to torpedoes. Even the gyroscope was not of much assistance, as the excessive vibrations in the hull interfered greatly with with its action.

CHAPTER XXVI.

Zédé's "Gustave Zédé," 1892.—It was generally conceded that the unsatisfactory performances of the *Gymnote* was due principally to her dimensions, and, therefore, in 1892 Zédé designed an enlarged *Gymnote* which was to be called *La Sirène*, but was renamed the *Gustave Zédé* after the death of its designer. This

*Translated from the Proceedings of the German Society of Naval Architects and Marine Engineers, Berlin, Germany.

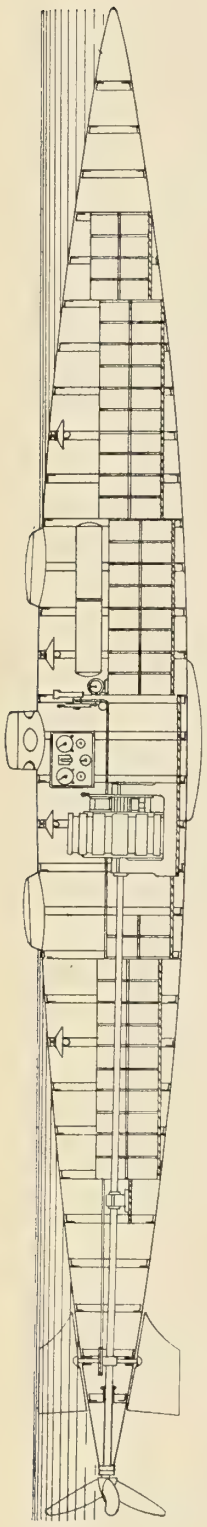


FIG. 57.—ZÉDÉ'S GYMNOTE, 1889.

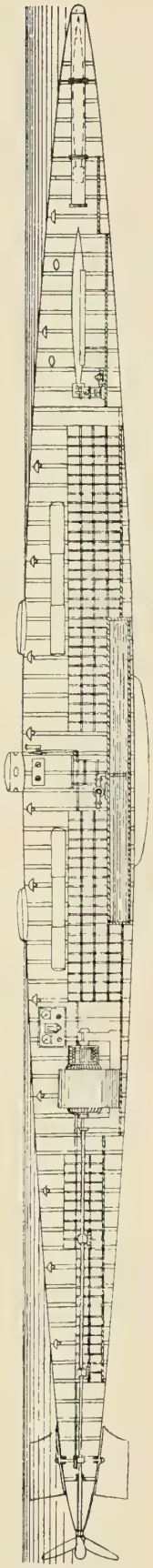


FIG. 58.—ZÉDÉ'S GUSTAVE ZÉDÉ, 1892.

vessel (Fig. 58) is 147 1-2 ft. long, 10 ft. 10 in. maximum diameter, displacing 260 tons of water. It is propelled by a 760 horse power Sautter-Harlé motor, with current from a battery of Laurent Ceby storage cells. The rising and sinking is effected by means of water ballast, and it also possesses the horizontal rudders, the same as on the *Gymnote*. Two tanks furnish the compressed air for launching torpedoes, as well as for breathing for the crew, and the foul air is pumped out by an electrically driven air pump. The trials of the *Gustave Zédé* were made secretly, and it is reported that she attained a speed of 15 knots at light draft, and 8 knots when nearly submerged. The French marine journal, *Le Yacht*, of December 2, 1899, reports that the *Gustave Zédé* made several trials in November, 1899, in order to test the new storage cells which were insulated with asbestos, and that during her trials she was accompanied by a tugboat. The editor added the following to the notice: "It seems strange that our submarine boats must always have an escort of either a tug or a torpedo boat, which gives us the impression that there is no great confidence placed in them, and tends to diminish the belief in their importance."

CHAPTER XXVII.

Romazotti's Morse, 1896.—The large dimensions of the boat *Gustave Zédé* evidently do not seem to have met with the approval of the French Navy, otherwise there would be no reason why, in 1896, a considerably smaller boat, the *Morse*, was built according to the plans of Romazotti. As the *Gustave Zédé* was an improvement over the *Gymnote*, so is the *Morse* an improvement over the *Gustave Zédé*. It could not be called a submarine boat, as it is intended only to float on the surface almost completely submerged. The *Morse* (Fig. 59) is 118 ft. long, 9 ft. maximum diameter, has a displacement of 146 tons, and carries only one submerged torpedo tube. It was launched July 8, 1899, at Cherbourg, and it was expected at her trial, at that place, that her 350 horse power electric motor would drive her at least at the rate of 10 knots when almost completely submerged. Various reports state that she has done as much as 12 6-10 knots. As soon as the trials of the *Morse* are finished, it is the intention to start building the sister boats, *Français* and *Algerien*, as the money for these has been collected by public subscription. It may be mentioned here that the *Morse* has cost about $130,000.00. The French Navy is also at present engaged in building four vessels of the *Narval* type at Rochefort. They will be named *Lutin, Farfadet, Gnome* and *Korrigan*.

CHAPTER XXVIII.

Laubeuf's Narval, 1899.—In October, 1899, the *Narval*, designed by Naval Architect Laubeuf, was launched at Cherbourg. The *Narval* is smaller than the *Morse*, as it measures only 111 1-2 ft. in length, 12 ft. 4 in. beam, and draws 5 1-4 ft. at her light draft, with a displacement of 106 tons. She differs from her predecessors, *Gustave Zédé* and *Morse*, in so far that she is built of steel, while the former were constructed of a special bronze called Roma-metal. The *Narval* will be equipped with an oil engine for heavy oil, built by Forest, and when floating light a speed of 12 knots is expected. When the boat is submerged, so

that only the conning tower projects above the water, the propeller will be driven by an electric motor fed by storage batteries, which are charged by a dynamo driven by the oil engine when she floats light. The former boats driven by electric motors and storage batteries only had a small radius of action, and had to depend on a central station to charge the storage batteries. The *Narval*, however, will be independent of the charging station, and is expected to have a

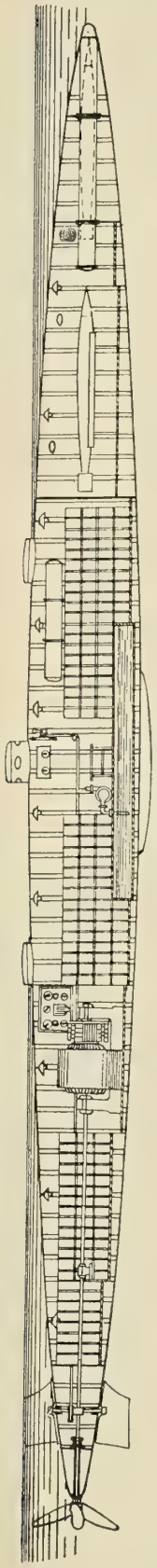
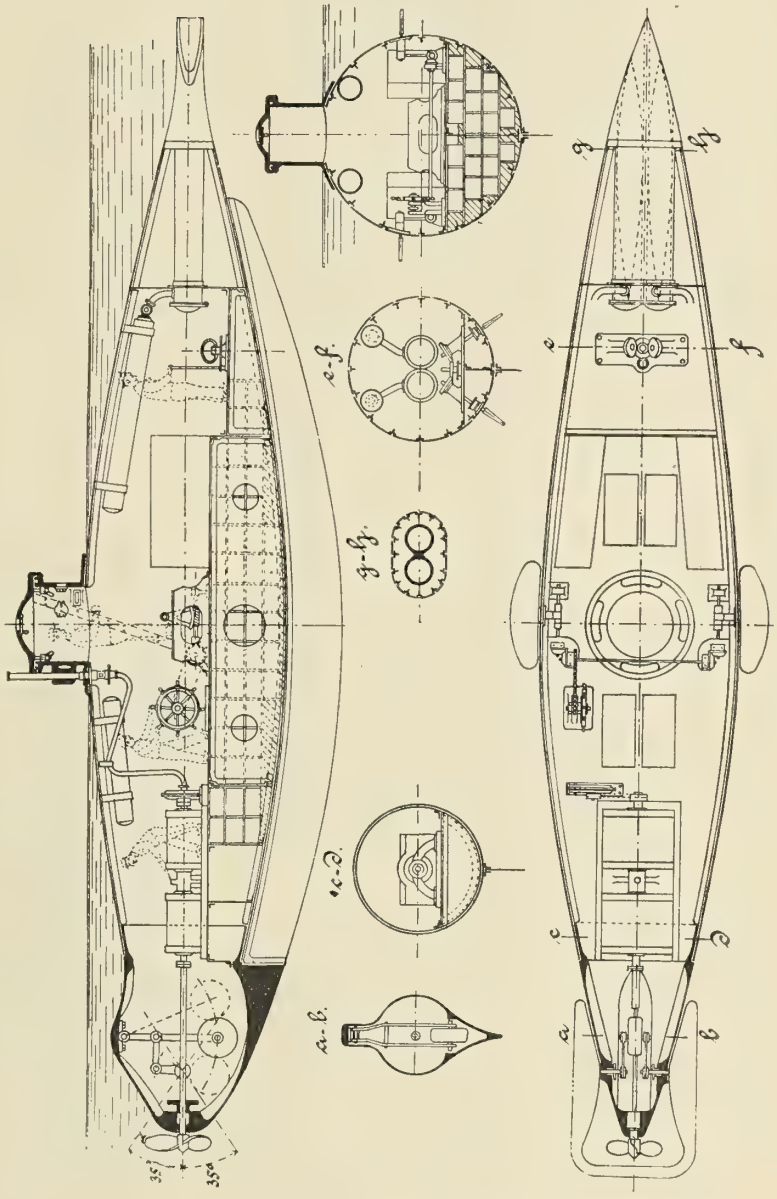


FIG. 59—ROMAZOTTI'S MORSE, 1896.



FIGS. 60-66—GIORLI'S BOAT, 1893.

radius of action of 252 miles at 12 knot speed, and 624 miles at 8 knot speed, when running light. When she has to depend on her storage batteries in the deep draft position, she is supposed to cover 25 miles at 8 knots speed, and 70 miles at 5 knots speed. Her armament consists of four torpedo tubes, two on a side, and the crew will consist of nine men and two officers. It remains to be seen whether the *Narval* will come up to expectations.

CHAPTER XXIX.

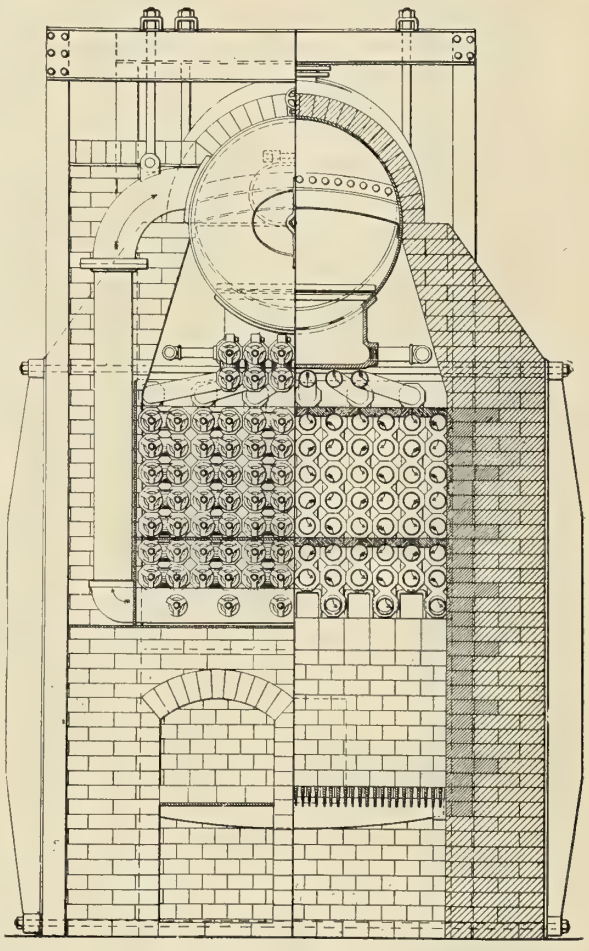
Giorli's Boat, 1893.—In 1893 an Italian, Giorli, designed the boat shown in Figs. 60 to 66. It is about 51 ft. long, 9 ft. 2 in. maximum diameter, and of 50 tons displacement. It is one of the first boats of this type which was intended to sail partially submerged, and only to go below the surface when in extreme danger. She was intended to be built with 16 frames running fore and aft, each frame of tee iron 7 in. by 3 1-2 in. by 1-2 in., and the bottom frame, which rivets to the keel, 8 in. by 4 in. by 1-2 in. The plating was to be 3-8 in. steel. The after part of the boat was to be a steel casting 1-2 in. thick, and the conning tower of cast brass 1-2 in. thick. A 30-horse power electric motor with current taken from storage batteries was to drive her for ten hours at a speed of 9 1-2 to 10 knots. Two horizontal side rudders are shown actuated by a hand wheel, and an after horizontal rudder connected with a pendulum to hold her horizontal, similar to Waddington's device. Figs. 60 to 65 show the usual water bottom for ballast, and fastened on the bottom amidships are two semi-cylindrical lead weights, each weighing 6 tons, which can be released to bring the boat to the surface in case of danger. The intention of the designer, as stated before, was that only the conning tower should project above the surface when in action, and under these conditions there would be a buoyancy of only 3-4 of a ton. The bow shows two bronze torpedo tubes, and the conning tower shows a pressure gauge to record the depth of submersion. A compass also is shown, but it is doubtful whether it ever would perform its duty, being surrounded so closely by the steel hull. An electrical driven fan, shown in Figs. 60 and 66, ventilates the interior by forcing out the foul air through the vertical pipe aft of the conning tower. The two steel cylinders above the engine (Figs. 60 and 65) are intended to hold compressed air for breathing for the crew of four men when the boat is entirely submerged. The Italian navy officials have always been favorably inclined towards the inventor, but to this day have not decided on the construction of the boat.

S.S. ESPERANZA.—The steamship *Esperanza* was launched at the William Cramp Ship & Engine Building Co. last month. She was built for the New York & Cuba Mail Steamship Co., and was christened by the daughter of the secretary and treasurer of the company, Miss Marjorie G. Smith. The *Esperanza* is the fourth steel steamship built for this company within two years, and is of these dimensions: Length, 341 ft.; beam, 47 ft. 6 in.; depth of hold, 36 ft. She will be fitted with two three-cylinder, triple expansion, surface condensing engines of the vertical marine type, with cylinders 23 1-2 in., 39 in. and 65 in. and 42 in. stroke. She will have four single ended boilers of the return tube cylindrical type, 15 ft. 2 in by 10 ft. 5 in. long. No wood except where absolutely necessary will be used in the construction of the ship. The vessel will be fitted with all modern improvements and there will be accommodations for seventy-five first cabin, forty second cabin, and seventy-five steerage. The *Morro Castle*, 6,000 gross tons, was built recently by the same yard for this company, and is now in the New York-Havana trade.

IMPROVED APPARATUS.

Parker Steam Generator.

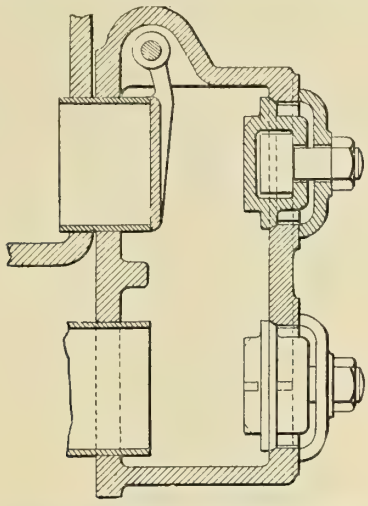
A novel and extremely interesting type of water tube boiler is shown in the outline of the Parker steam generator herewith. While at first glance this boiler appears to be similar in design to other boilers of the large tube type, closer examination shows that it possesses several radically different features. The boiler in the sketch was designed for land use, and is only one of many forms in which the generator can be constructed, but it serves to illustrate the principle. In this generator the circulation is positive and in one direction only. The boiler shown has one drum (other designs show separate steam and water drums) divided into separate steam and water compartments, the latter being the lower. A steel diaphragm separates the chambers. This is slightly curved upward to resist the excess of pressure which is occasionally created in the lower chamber by the closing of an anti-priming valve in the connection between the chambers. The feed enters the water drum and flows downward by gravity into a cross steel box at the front end of the boiler just below the drum. From this it passes into the generating tubes. The



PARKER WATER TUBE BOILER.

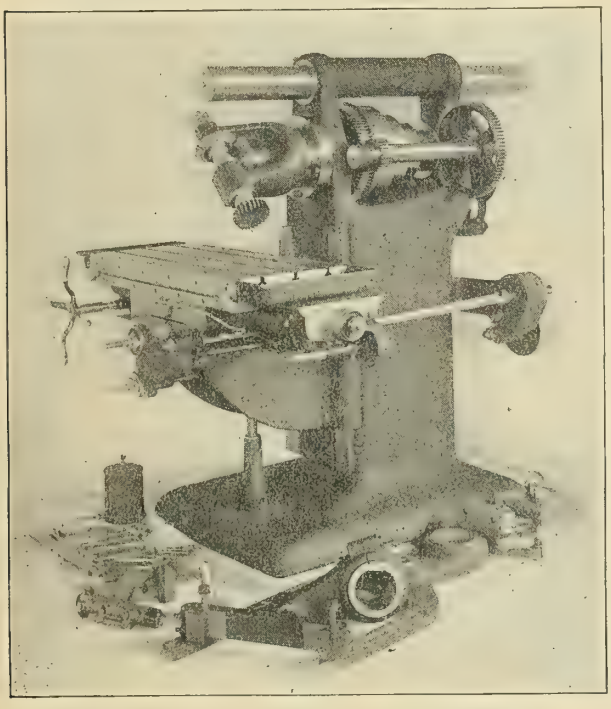
tubes are horizontal and arranged in vertical groups—elements—in the form of flattened coils. These elements are two tubes wide, the tubes being expanded into junc-

tion boxes which form the bends. At the head of each element in the junction box there is a swinging check valve, which permits the flow of water in one direction only—downward. The water flows continuously down-



SECTION OF JUNCTION BOX, PARKER BOILER.

ward to the bottom row of tubes, forming the furnace crown, and this row is connected at the front end to a horizontal header which terminates at each side in an upcast pipe connecting with the steam chamber in the drum. It will thus be seen that the water flows downward by gravity as fast as evaporated with the resultant condition of a descending column of water and an ascending column of steam. The coldest water is next the coldest gases, and the flow is in opposite directions



BECKER-BRAINARD HORIZONTAL MILLING MACHINE.

—the conditions most favorable to economy. There is little or no recirculation of water, for the aim is to so proportion the length and capacity of the tubes that complete evaporation is secured in one circuit. On account of the length of the elements and the progressive heating, the coldest water can never reach the hottest tubes; the metal at any given point remaining at practically a constant temperature. Another desirable feature is that the water drum is not subjected to high temperatures, and, owing to the entire absence of ebullition, forms an effective settling chamber, suitable apertures being provided for blowing out sediment. In operation, when a drop in pressure occurs, the upflow from the water chamber closes the check valve between the steam and water chambers, and so long as any difference in pressure exists the valve will remain seated. This effectually prevents priming, and also maintains the flow in the tubes. A by pass connecting the steam space in the water drum with the dry steam chamber is provided, which prevents an excessive difference in pressure during these periods. A structural feature on which the makers put emphasis is the readiness with which every part of the interior or exterior can be examined and cleaned. The junction boxes are so grouped that there are considerable spaces left at the ends which can be utilized for brushing or blowing off the exterior of the tubes. Hand holes in the junction boxes are closed by circular covers ground on their seats, and held in place by T headed bolts and spiders. The covers are held on their seats by the internal pressure. Should a leak develop, after pressure is on, the bolt and spider are removed and a slight turn with a grinding key brings the cover to a seat. The tubes are usually 3 in. dia. and expanded in the junction boxes. Incrustation in this type of boiler is prevented by automatic cleaning. This occurs when the by pass valve is closed and there is an excess of pressure in the water chamber, owing to any heavy withdrawal of steam from the steam chamber or to the rapid condensation of steam which occurs when cleaning or banking fires. A column of solid water is then forced through each element. The water carrying the sediment is discharged into the steam compartment where it drains into the water space, as soon as the anti-priming check reopens. No scale or mud lodges in the steam drum, but is invariably deposited in a heap directly below the anti-priming valve, where a blow off connection is provided. A boiler built on this system has been in regular service for some time at the Roach shipyard on the Delaware, and has been subjected to severe tests. Four steam hammers have been thrown on at once, in addition to the regular load carried, and while the pressure has dropped as much as 20 lb. suddenly, there has been no observed change in the water level nor in the dryness of the steam. It is the invention of J. C. Parker, and the owners have opened sales offices in the Drexel Building, Philadelphia, Pa.

Horizontal Milling Machine.

An improved form of plain horizontal milling machine brought out by the Becker-Brainard Milling Machine Co. is shown in the engraving. It is a machine of great strength, with a powerful drive and extra length of saddle, the great length of feed and table movement giving the machine the widest range of work. The table can be operated from the front or either end, as may be most convenient. The machine is provided with a very powerful vertical spindle and

angular attachment. Its spindle is bored to coincide with the main spindle, therefore all cutters fitted to the fole of the main spindle can be used with the vertical spindle. The head can be set to any degree of angle, and is well adapted for rack and slot cutting in line with the spindle. The rack cutter is run on an auxiliary spindle connected with the angular attachment and is set to run between the bearings central with the axis of the vertical spindle. The unusual range of the cross feed of the table will allow of end milling with the vertical spindle set in a horizontal position, at a right angle with the main spindle. The rotary attachment has a graduated table and is fed automatically in either direction by means of a gear bracket and interchangeable feed gears, giving 32 changes of rotary feed. Adjustable stops are provided to trip the rotary feed automatically at either end of the segment. The main spindle is provided with adjustable bronze boxes. Arbors, mills and collets are rigidly secured by means of a draw-bar. Backing out is neatly done by unscrewing the draw-bar at the rear end of the spindle. The machine illustrated shows a 4-step cone for 3 1-2 in. belt, and is back geared 10 to 1. Diameter of the largest step 14 3-4 in., small step 6 1-2 in., giving, with two counter speeds, 16 changes of spindle speeds. When preferred a 3-step cone with 4 1-2 in. belt is furnished to order in place of the 4-step cone. All table feeds are automatic in either direction and instantly reversible. Automatic stops are provided for tripping the feed lever.

Adjustable Wedge Gate Valve.

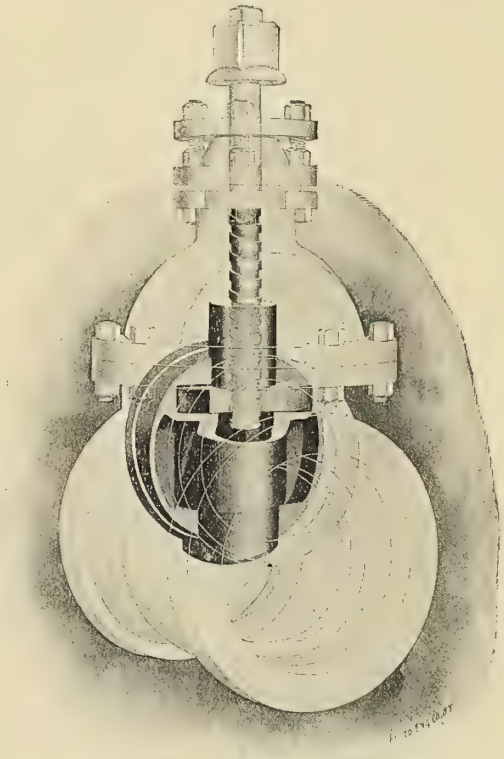
In the sectional engraving of a gate valve is shown the construction of the Vincent adjustable wedge straightway valve. This is of the double gate type, with straightway passage the full size of the connecting pipe. It will be observed that the stem nut has no duty to perform except to raise and lower the gates, the operation of seating the gate being performed by the adjustable wedge alone. In closing the valve the wedge does not function until the gates are on their seat, thereby avoiding any sliding contact and reducing the wear of the faces to a minimum. With these valves, the pressure can be applied from either side, as may be most convenient in location. They are made in a great variety of sizes and styles, including valves with bronze or iron bodies, screwed or flanged ends, with indicators, and without and with quick (lever) opening as desired. They are manufactured by the Vincent Valve Co., and handled by Sweet & Doyle, Cohoes, N. Y., who are the selling agents for the makers.

Yacht Saluting Gun.

Saluting and signal guns on vessels are usually of the antiquated pattern of muzzle loader, which is awkward to manipulate, besides being anything but a desirable fitting for a "smart" yacht. A new type of gun for this purpose is that shown in the photograph, which is modeled on the Hotchkiss naval pattern rapid fire weapon. The gun, as shown, is supported on a conical base at a convenient height for loading and pointing. It can be manipulated rapidly and can be fired either by hand or electric connection from a station in any part of the yacht. Standard brass and gun metal is used in the construction, and the gun can also be finished in dull navy black, nickel or oxydized. It takes up little room and is through bolted to the deck, so that there is no trouble with lashings in a seaway. It is built by the Naval Electric Co., 95 Liberty street, New York.

Davis Foot Power Lathe.

On most steam vessels, especially those making long voyages, a most useful addition to the engineers' equipment is a good lathe, on which the thousand and one odd jobs that have to be done can be executed without delay. It is not always convenient or necessary to have a power lathe, and to meet the demand for a reliable foot lathe the tool shown in the engraving has been designed. It is

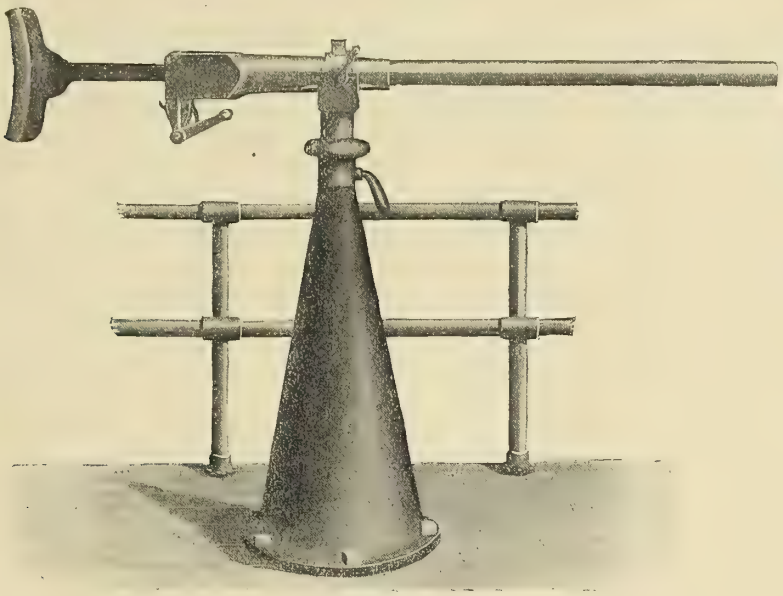


VINCENT ADJUSTABLE WEDGE VALVE.

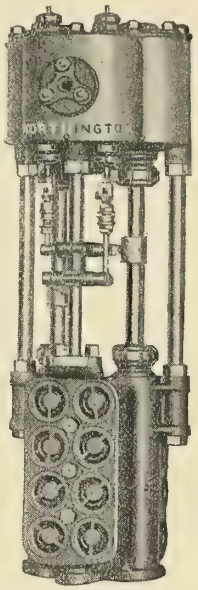
a 10-in. screw cutting lathe, with power cross feed, thrust ball bearing on the spindle, with crankshaft roller bearing and all modern improvements, including pan. The driving wheel is overhung so that the belt is well out of the way of the operator, and yet readily accessible for a change of speed. Following are some of the principal dimensions of this lathe: Front bearing, 2 3-4 in. long and 1 1-2 in. dia.; back bearing, 1 7-8 in. long and 1 1-4 in. dia.; nose of spindle, 1 1-2 in. dia. and 10 threads to inch; hole in spindle, 9-16 in., conforms to Morse taper; swing over ways, 10 1-4 in.; swing over rest, 6 in.; distance between centers, 32 in. On this lathe screws can be cut from 4 to 48 threads to the inch. The weight of the lathe is 550 lb. It is made by the W. P. Davis Machine Co., Rochester, N. Y.

Duplex Boiler Feed Pump.

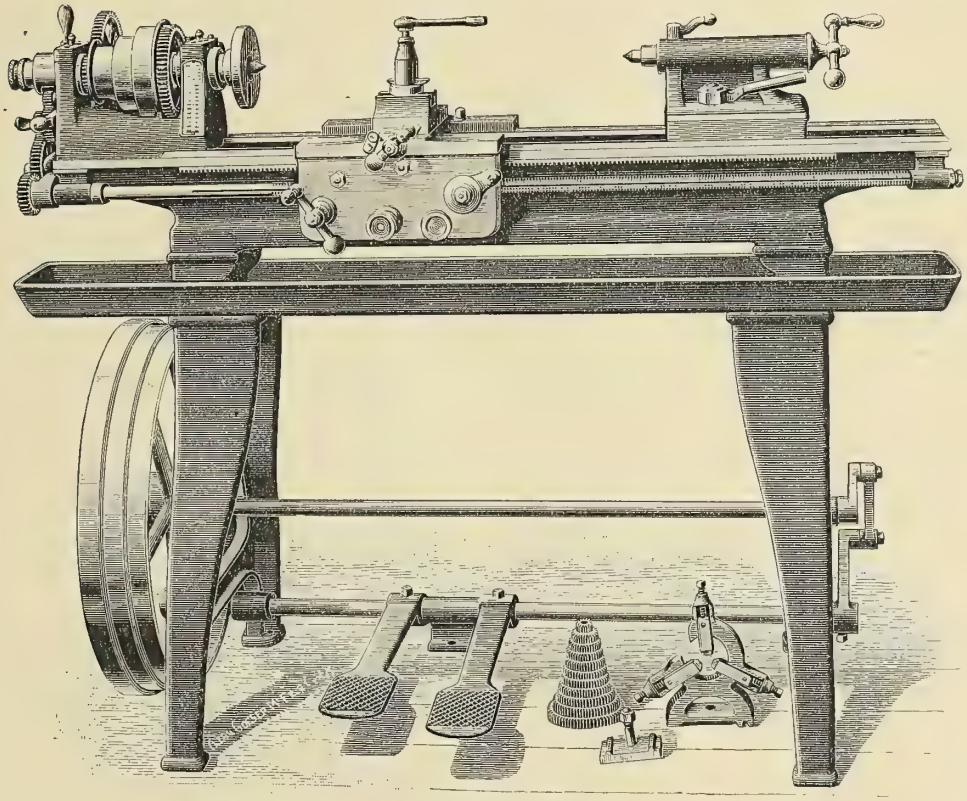
A special light weight feed pump designed for the S.Y. *Arrow* and built by the Worthington Pump Co. is shown in the illustration. This pump is of the duplex type, 4 1-2 in. and 2 1-2 in. by 4 in. There will be two fitted in the boat, one for each boiler, with a combined capacity for 4,000 I. H. P. when the boat is developing full power. Each pump weighs only 260 lb., and is built to work against a maximum boiler pressure of 400 lb. per sq. in. When doing maximum work the pumps are capable of delivering 28,000 lb. of water per hour. When completed the pumps were severely tested with water at 180 deg. temp., and stood up to their work without failure.



YACHT SALUTING GUN.



WORTHINGTON FEED PUMP.



DAVIS FOOT POWER LATHE.

MARINE ENGINEERING

PUBLISHED MONTHLY

BY

ALDRICH & DONALDSON,

309 Broadway, New York.

Editorial Department,
H. F. DONALDSON.

Business Department,
H. L. ALDRICH.

Branch Offices,

Philadelphia, Pa., Mach'y Dept., The Bourse, S. W. ANNESS.
Detroit, Mich., Hodges Building, L. L. CLINE.
Boston, Mass., 170 Summer St., S. I. CARPENTER.

TERMS OF SUBSCRIPTION,

	Per Year.	Per Copy.
United States, Canada, and Mexico.....	$2.00	20 cents.
Other countries in Postal Union.....	2.50	25 cents.

Entered at New York Post Office as second class matter.

Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

NO subject has received more attention, in recent times, in the technical and critical press of the world, than that of American competition. In all the arguments used to explain the present preëminence of American engineering, one agency which has been overlooked, to an extent, we believe, is the growth of the splendid professional spirit which is characteristic of American practice to-day. One of the strongest evidences of this is to be found in the technical publications of this country, especially when comparisons are made with similar foreign publications. We use the term publication as inclusive not only of the periodical press, but of the transactions of the scientific societies and the various papers and books issued by the U. S. Government and others at irregular intervals. Any person whose observation extends over the field of current technical literature cannot fail to be impressed with the broad spirit which is displayed by the American engineer in the communication of facts and figures, gathered in his own practice, to his fellow workers. This is strikingly apparent, too, on personal contact with American and foreign engineers and manufacturers. Here offices and shops are thrown open to the visitor, often on slight acquaintance, processes are described and permitted to be inspected in operation. Abroad, on the contrary, the visitor usually meets with closed doors and sealed lips, even when armed with the strongest credentials. If he is permitted to view a plant or process, he is usually escorted by some polite nonentity, who so far as imparting any information is concerned might as well be a deaf mute. There are notable exceptions, of course, but speaking broadly, the conditions are as stated. If knowledge is power, then the methods adopted in America must be productive of material aid in the fight for commercial supremacy. Possibly the chief exponents of the dark lantern methods are the British engineers. Pick up a British engineering publication, and you are much more likely to find data and drawings of some American or Continental (European) machine or structure than of a British one. There will be, probably, some reproductions of photographs of British machinery, but dimensioned drawings or data—not! Or, take the proceedings of a British technical society, and compare the number of actual working drawings and specifications contained in its volumes with those to be found in the transactions of similar societies on this side of the Atlantic. In no country is the art of talking and saying nothing so highly developed as in Britain, as a perusal of the discussions before their technical societies will disclose. Much of the credit for this high professional spirit here must be given to the various technical colleges of this country, of which so many of our practicing engineers are graduates. It is noticeable among us, too, that the concerns that turn out the best work are those most willing to give out their experiences for the benefit of the profession and country at large. They have the consciousness of doing good work and are proud of it. In our special branch of engineering construction, the influence for good in this direction of the U. S. Navy departments is very great indeed. In the detailed reports of the various bureau chiefs and publications of the different departments, there is a mass of data vastly more complete and educationally helpful than that which any other nation has made available for consultation. In matters of pure science or abstract reasoning, scientists of foreign nations are very generous in their contributions to the sum of get-at-able knowledge. It is not to this class that our remarks are intended to apply, but rather to those more directly concerned with the commercial side of engineering.

NOW that a number of the great steel producing concerns of the country are consolidated, under the title of the United States Steel Corporation, it is to be hoped that the oft repeated statement, that the formation of a trust leads to a reduction in the price of output, will become a tangible fact. As many of our shipbuilders have often said, the excessive fluctuations in the price of ship material here are not helpful to the shipbuilding industry. Stable conditions are desirable in the material market, even if they are undesirable on the floor of the Stock Exchange, and if our shipbuilders are to compete successfully with the foreign builder they must at least be in as good a position, as to the price of plates and shapes, as he is. Again, the delivery of plates to yards abroad for less than they can be purchased here, by our own builders, is an anomaly which ought not to be heard of in the future. In this connection, the recent rejection of a lot of ship plates sent from Pennsylvania to Belfast, Ireland, has been made the subject of congratulation by a section of the British press. It appears that it was a rush order and that the plates were shipped before Lloyd's inspector arrived at the mill. Tests of the coupons, which had been held at the mill, were made subsequent to the shipment of the plates. The results did not satisfy the inspector, and the entire lot was condemned, the mill at once getting to work on a duplicate order. This was apparently a case of carrying out the letter of the law. It is not unusual for very different results to be secured from tests of coupons and plates, an unaccountable variation being shown in the finished plate and the test pieces originally cut from it. In a paper read by George W. Dickie before the Technical Society of the Pacific Coast, he pleads for the exercise of "judgment" in the application of physical tests, and says:

> We often have plates of steel where the test pieces, cut directly from the plate, will give fine results—say 60,000 pounds tensile strength and elongation of 30 per cent. in 8 in., and will double over on themselves without sign of fracture, and yet the plate itself would break like glass in bending over a large radius. I have cut test pieces right out of plates that would not bend at all, and the test pieces would double over on themselves without sign of fracture. Not long ago I had a plate of government material to bend on the press for a keel plate, but the plate broke hopelessly in bending. There was no other plate to replace it of material that had been tested and accepted for government use, and the inspector would not allow any other plate to be taken for the purpose. I, however, took a plate of steel for merchant work and bent it to the required form with no sign of fracture. We cut a test piece out of the broken plate, right by the fracture, and it showed 61,000 pounds tensile strength and 28 per cent. elongation, and bent over on itself without fracture. Then we took a test piece out of the plate that had been successfully bent to the desired form and showed 62,000 pounds tensile strength and 22 per cent. elongation, and it broke before it had completely bent over on itself. Therefore the perfectly bent plate was not allowed to be used because the test piece did not meet the requirements.

In the case of the recent rejection of the Belfast shipment it would have been much more conclusive if tests had been applied to the plates, to see whether or not the defective test pieces fairly represented the quality of steel in the shipment.

A RECENT alarm of fire on one of the Atlantic coast liners, caused by the ignition of woodwork in the upper portion of the engine room, recalls attention to the dangers which lurk in the extensive use of combustible materials in the finishing and furnishing of modern passenger steamers. The most severe lesson of recent times was the fire which occurred at the North German Lloyd docks at Hoboken, North River, N. Y., last summer. Previous to that the conflagrations on the Spanish ships in the Santiago fight gave warning of the danger of woodwork in ships, which has been heeded by naval authorities since. In the case of the Clyde liner, *Comanche*, to which we referred in opening, the prompt work of the vessel's crew prevented the possibility of disaster. There was a heavy sea running at the time and there were many passengers on board, tourists bound for Florida pleasure resorts. The problem of fitting out a vessel with incombustible materials is, we believe, one worthy of careful consideration and experimentation by the naval architect and shipowner. It is a much more difficult problem in merchant work than in naval construction, for the reason, chiefly, of first cost and decorative effect. Fireproofed wood is usually difficult to work, and its use greatly increases the cost of labor in the woodworking departments, which, of course, the shipowner has to pay for. Then the use of metal and uninflammable compositions, in which asbestos figures largely, has not reached a stage where its employment is optional. In a warship much of the steel work is covered simply with cork paint, to prevent the disagreeable sweating, but this is not a pleasing form of decoration.

EDUCATIONAL DEPARTMENT.

ELECTRICITY ON BOARD SHIP—PRINCIPLES AND PRACTICE—XXV.*

BY WM. BAXTER, JR.

Search Light Projectors.

A searchlight projector is simply an arc lamp which is so arranged that all the rays of light may be directed in one direction. The light is concentrated into a beam of the desired form by means of reflectors and lenses. The ordinary projector is arranged so that the beam of light may be made nearly parallel, or it may spread out like the rays from a locomotive headlight. Some projectors are constructed with lenses that can change the form of the beam of light, so that it may be spread out into a horizontal band of considerable width or be concentrated into a circular cross section.

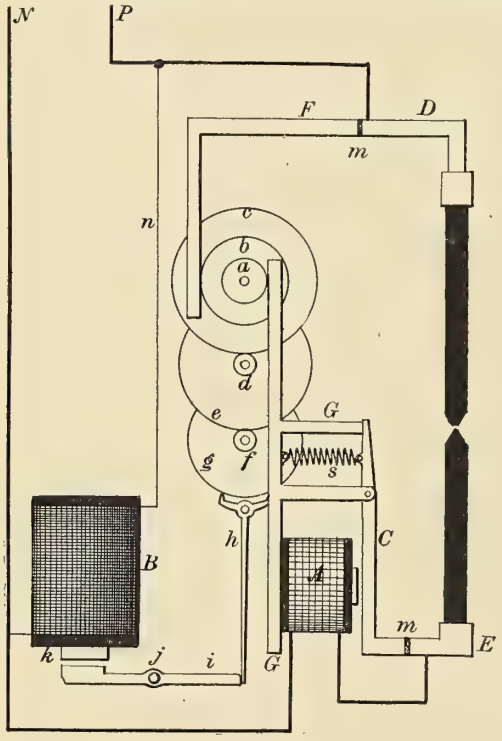


FIG. 163.

The horizontal band of light is particularly valuable for exploring a shore line.

The mechanism of an arc lamp intended for use with a projector has to be decidedly different from that used for ordinary purposes. With the simple lamp all that is required is that the feeding mechanism be capable of maintaining the distance between the ends of the carbon rods as nearly uniform as possible, so as to obtain a steady light. In the projector, however, it is not only necessary to maintain the carbon points at a uniform distance, but, in addition, they must be kept in the same place. If only one of the carbons burned away, there would be no difficulty in maintaining the arc in the same place at all times, but as both rods are consumed, it is clear that if the top one feeds while the lower one does not, the position of the arc will gradually move down as the lower rod burns away. If both carbon rods are of the same diameter, and of the same structure, the upper one will be consumed at a rate about twice as great as the lower one; hence, if we desire to keep the arc always in the same position, the top rod must feed down twice as fast as the lower one feeds up. If the top carbon is made larger than the lower one, it will not be consumed

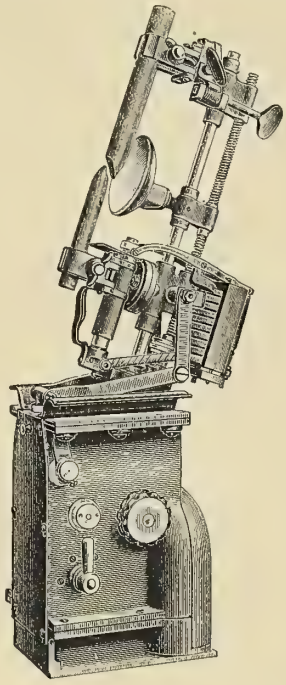


FIG. 164.

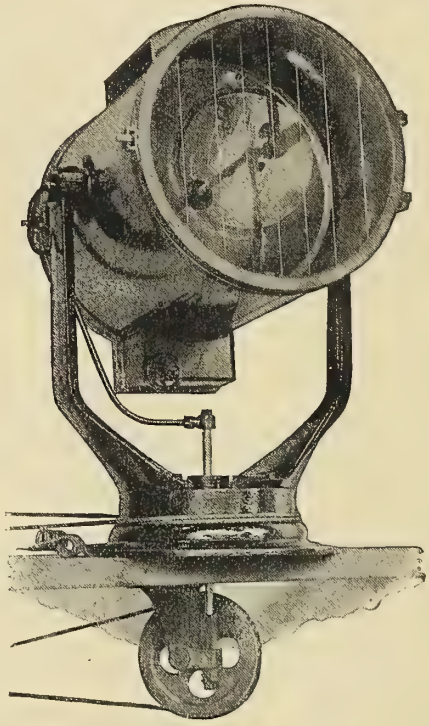


FIG. 165.

*Concluding Chapter of this Series.

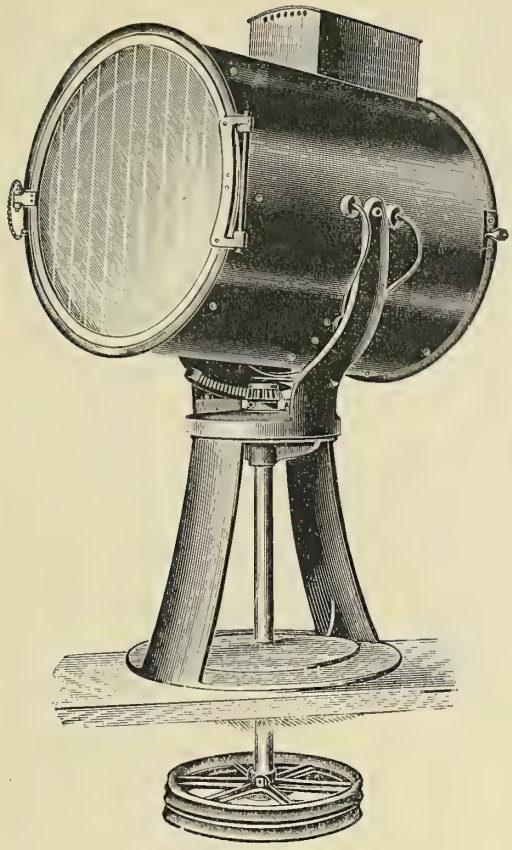


FIG. 166.

twice as fast, in fact, it can be made so as to burn away at a slower rate than the lower one by sufficiently increasing its size.

It will be evident from the foregoing that there are many ways in which the mechanism of a projector arc lamp may be made so as to accomplish the required result. The general principle of construction and ac-

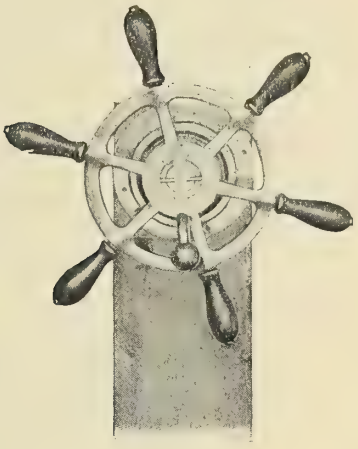
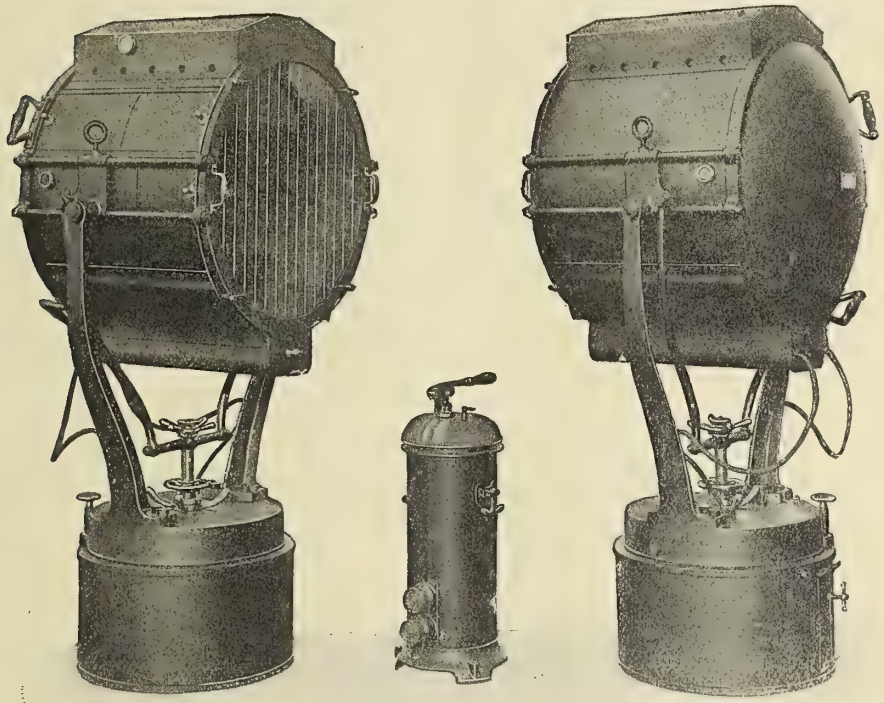


FIG. 167.

tion of such mechanism is shown in Fig. 163. The upper carbon is secured to *D*, and the lower one to *E*. The upper holder *D* is mechanically connected with *F*, but is insulated from it electrically, as is indicated at *m*, and in like manner *E* is mechanically connected with *C* and electrically insulated from it at *m*. The lever *C* is carried by a frame *G*, upon the upper end of



FIGS. 168, 169.

which there is a rack which meshes into the wheel *a*. The frame *F* is also provided with a rack, which meshes into a wheel *b*. These two wheels, *a* and *b*, are made of such diameters that when they rotate, they draw

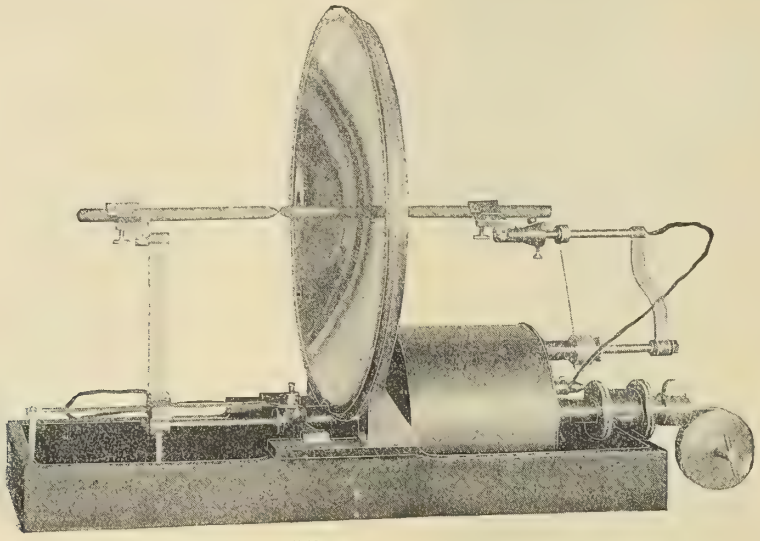


FIG. 171.

down *F* and raise *G* at the same rate at which the upper and lower carbons burn away, so that at all times the arc is in the same position.

The wheels *a* and *b* are mounted upon the same shaft as wheel *c*, and this latter meshes into a pinion *d*, which is carried on the same shaft as wheel *e*. This

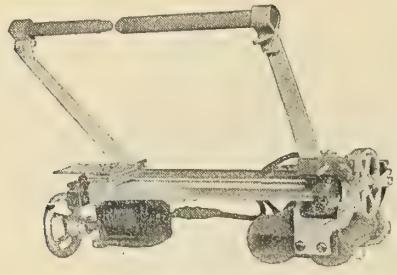


FIG. 172.

latter wheel meshes into pinion *f*, which is mounted on a shaft that carries an escapement wheel *g*. This train of gearing can be arranged to run by means of a spring, like an ordinary clock, or it can be operated by gravity. If the frame *F* is heavier than *G*, the weight that descends will overbalance that which ascends, and thus there will be a surplus of energy which can be used to drive the train of gearing.

By means of the escapement lever *h*, the motion of the train is controlled, and this lever is itself under the control of magnet *B*. The operation of the mechanism is as follows: When the current is turned on, the carbon points are in contact, and all the current, except a very small fraction, passes through them and through magnet *A*, and thence to line *N*. The magnet *A* at once draws lever *C* toward it, and thus separates the carbons, and from this time onward *A* has nothing to do; in other words, the only office of this magnet is to separate the carbons and form the arc. As soon as the arc is established, a sufficient current will be forced through magnet *B* to enable its pole *K* to act strongly upon the lever *i*. As the carbons burn away, the force of *B* increases, and when it becomes sufficient, *i* is drawn down far enough to allow *h* to swing freely. When this stage is reached, the train of gearing will be set in motion, moving tooth by tooth as the lever *h* swings to and fro. From this it will be seen that the feed of the carbons is gradual, and when they have

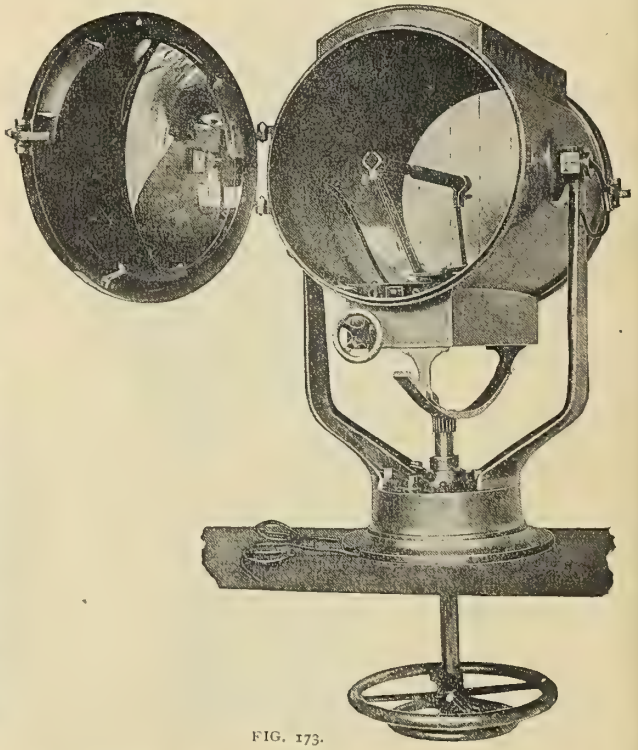


FIG. 173.

been brought near enough together, the force of *B* will be so far reduced that *i* will swing back into the path of *h*, and thus arrest the movement of the gear-

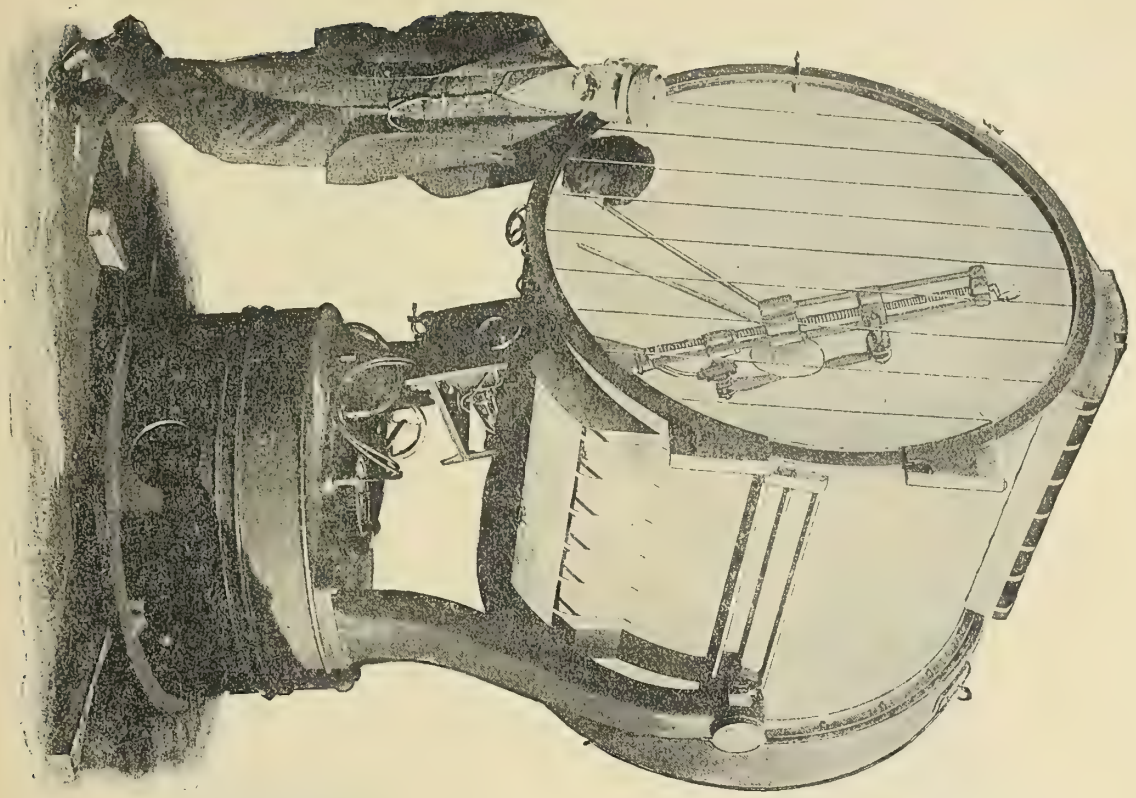


FIG. 175.

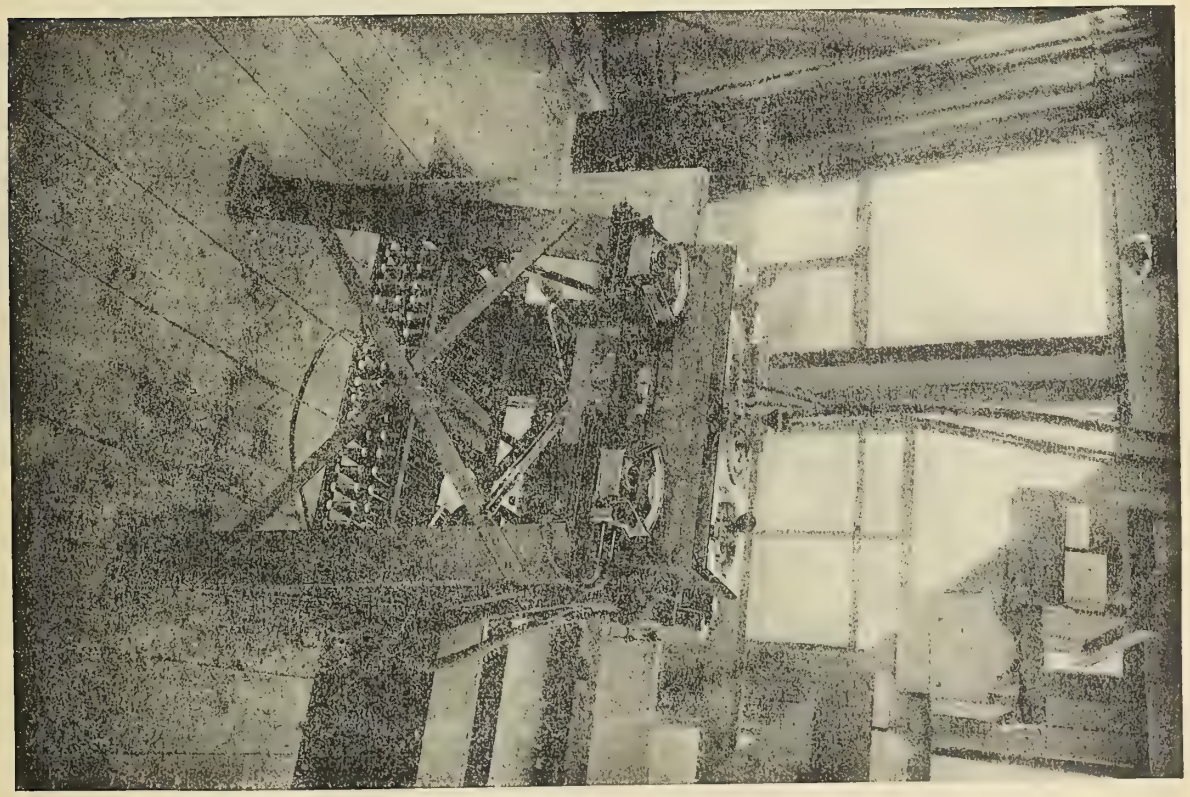


FIG. 176.

ing. It will be noticed that the position of the pivot around which *C* swings is so situated, with reference to the position of the carbon points, that when it is drawn toward the pole of magnet *A*, the lower carbon will be thrown forward of the upper one. This is done

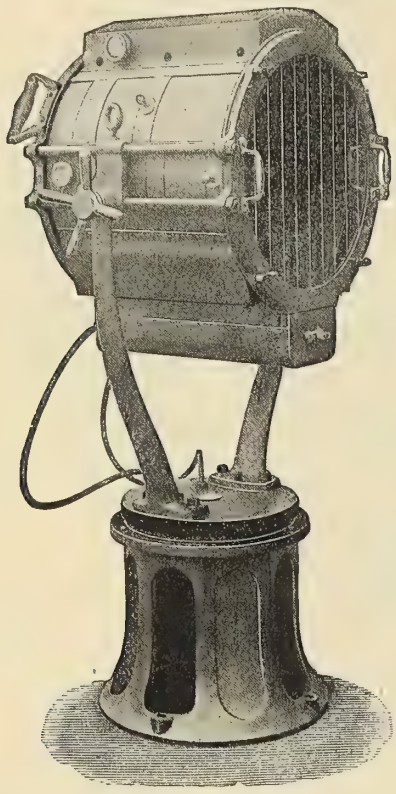


FIG. 174.

purposely, so as to have the most powerful rays issuing from the arc projected directly against the reflecting lens. This position of the carbon points is more clearly shown in Fig. 164, which illustrates the lamp for projectors made by the General Electric Company. The reflector seen to the right of the carbon is not the true reflector; it is in reality more of a screen than a reflector, as is more fully explained in connection with Fig. 176. The magnet seen at the lower right hand corner acts to spring the arc, that is, it is the magnet *A* of Fig. 163. The beam of light is trained to any point of the compass by swinging the whole lamp, reflector and all, around its vertical axis. To elevate or depress the beam, the lamp is swung upon the trunnions that support it. The lamp illustrated in Fig. 174 is designed so that it may be operated by a man stationed at its side, as will be understood from an inspection of the figure. Fig. 175 shows a construction by means of which the movement of the beam is effected by manipulating a lever extending below its base.

The arrangement shown in these illustrations is not always desirable, as it may not be convenient to so place the lamp that the levers projecting directly below it will be in an accessible position. On that account the operating mechanism is also made so as to be operated from a point not directly under the light. Fig. 165 shows the construction employed by the Carlisle & Finch Co. As will be seen, two driving ropes are used, one to rotate the whole lamp so as to adjust the beam of light horizontally, and the other to swing the lamp cylinder in a vertical plane, so as to give the beam of light the proper elevation. Fig. 166 shows the arrangement used by Thos. P. Benton & Sons. In this design horizontal movement is given by rotating the upper one of the two rope wheels, this being secured to a hollow shaft, which, when turned, swings the whole lamp. To obtain the vertical movement, the lower rope wheel is turned, and this is secured to an inner shaft, which carries at its upper end a bevel gear that meshes into a curved rack attached to the underside of the lamp cylinder. Fig. 167 is the hand wheel and crank handle, by means of which the ropes that run over the rope wheels are operated.

Searchlights are also arranged so as to be trained electrically. The motion is obtained by means of electric motors, two being used in most designs, one for the horizontal, and one for the vertical motion. Fig. 168 shows a lamp of this type made by the General Electric Co. The operating motors are located in the base, and their motion is controlled by the controller shown in Fig 169, which is placed in a convenient position and is connected with the motors, in the searchlight base, by means of a cable consisting of seven wires well insulated from each other. With this design of controller the beam of light can be moved in any desired direction, but the intensity of the light

FIG. 175.

cannot be controlled. By means of the controlling device shown in Fig. 170, not only can the beam of light be directed to any point of the compass, but in addition, the strength of the current passing through

the carbons, and also its voltage, can be varied as desired. On the front of the stand in this illustration can be seen two instruments, one of which is an ammeter, and the other a voltmeter. These indicate the strength and voltage of the current that operates the lamp, that is, the light-giving current. Under the stand is located a rheostat, by means of which this current can be regulated when the instruments show that it is not of the proper voltage or amperage. The two switches seen back of the instruments are for the purpose of controlling the motors that move the lamp.

In some searchlights the lamp is arranged so that the carbons are in a vertical position; in some they are inclined, as in Fig. 164, and in others they are in a horizontal position. In the lamp, Fig. 166, the carbons are held in the horizontal position. The working parts of this lamp, together with the reflector, are shown in Fig. 171.

In the Carlisle & Finch lamp the carbons are also in the horizontal position. The mechanism of this lamp is shown in Fig. 172, and its position within the cylinder is clearly shown in Fig. 173.

Fig. 174 shows the appearance of a complete projector arranged so that the beam of light may be moved around by hand. Fig. 175 shows another form of searchlight, in which the direction of the beam is controlled by means of levers. This arrangement is used when it is desired to control the light from a distance, as for example, when it is located upon the roof of a pilot house and is to be controlled from below.

Fig. 176 shows a 60-in. projector, which is the largest made by the General Electric Co. Its total weight is about 3 tons, and it stands nearly 11 ft. high. The lamp proper weighs about 400 lb., and is 6 ft. high. The carbons used are 1 1-2 in. dia. for the upper one, and 1 1-4 in. dia. for the lower. The current used is 200 amperes, and the light can be plainly seen at a distance of over one hundred miles.

The position of the lamp with reference to the reflector, and the cylindrical casing is well shown in Fig. 176. The reflector is located at the back end of the casing. The carbons are inclined with the upper part toward the front, so as to project the strong rays of light from the end of the upper carbon directly toward the center of the reflector. As can be also seen, that which appears to be the reflector in Fig. 164 is in front of the carbons in Fig. 176, and acts mainly to prevent the dispersion of the rays that issue from the front of the arc, and which, without this shield, would radiate outside of the projector. All the mechanism is placed forward of the carbons, so that the rays projecting backward upon the reflector may not be intercepted at any point.

The projectors ordinarily used on ships are of the 12 in. and 18 in. sizes, and are, as a rule, either gear or electrically controlled.

The reflectors of the projector are made of metal and also of glass, with a silvered back. When made of metal they are of parabolic shape, so as to concentrate the beam of light, but when of glass the surfaces are spherical, and the concentrating effect is obtained by making the rim thick and the centre thin.

TECHNICAL PUBLICATIONS.

PRACTICE AND THEORY OF NAVIGATION. By the Earl of Dunraven. Extra Master. First Edition. Macmillan & Co., London. The Macmillan Co., New York. 2 Vols. Size, 6 by 9. Pages, 743. With many diagrams. Cloth, $7.00.

The Earl of Dunraven has written a book on navigation for the use of amateurs and merchant seamen, also for the benefit of men desiring to pass the British Board of Trade examinations for mate, master or extra master. It is a good book and testifies that the titled author, who is a passed extra master, is a genius in the navigator's art. It has its faults, but they are minor ones, and its virtues may be said to adequately overshadow its shortcomings. To employ a paradox, and to take advantage of literary license, it might pertinently be said that some of its shortcomings are its longcomings, for in several instances explanations are carried a little too far. Sometimes, after a clear and comprehensive digest has been given the subject, it is rehearsed in a way perhaps calculated to leave the average reader's views less clear than before. This is a fault seemingly common to English scientific writers, and "Lecky's Wrinkles on Navigation," a most masterly work in general, is no exception to this.

Dunraven's Navigation presents no new or original theories for the navigator, but seeks to serve up old established rules in a plainer and more wholesome way, and it cannot be denied that this has in numerous instances been most happily accomplished. The author takes the reader entirely into his confidence, and talks with him familiarly and in a most friendly manner. Especially is this true in the preface, which is written in a very happy vein, and from which the following is quoted:

"Navigation is in many respects a peculiar subject. All the problems being based upon the higher mathematics and astronomy, the solution of them can be calculated and formulated only by men thoroughly conversant with those sciences; but navigation has to be put in practice by men who are not, and cannot be expected to be possessed of much knowledge of those matters. * * * Few things appear to be more difficult than for one well up on any subject of a scientific character to impart his knowledge to another who is scientifically ignorant."

The book starts off with the arithmetic of navigation, and this is well expressed, although a little more exhaustive than necessary for the use of the merchant navigator. Next follows the mariner's compass, treated from a purely mechanical standpoint, and in relation to this subject it is to be regretted that the theory of terrestrial magnetism is not even touched upon, the author dismissing the question with the following peremptory and unsatisfactory reference:

"The needle very rarely points to the north and south poles of the earth; if it did, the mariner would be relieved of much anxiety and bother. It points towards what are called the north and south magnetic poles of the earth, situated in about latitude 70° north and longitude 97° west, and in latitude 74° south and longitude 147° east. Why it points in that direction

goodness only knows; but it does—that is to say, it does when no disturbing causes affect it."

Plane, parallel, middle-latitude, Mercator's, and traverse sailings are intelligently treated, and algebra and plane trigonometry are gone into in as simple a way as possible, and to considerable extent, in order to exhibit to the unmathematical navigator the foundation of some of the daily problems he works only mechanically. The question of tides, and the method for calculating high water are generously considered, and charts and chart-sailing are clearly demonstrated: but the chapter on the chronometer is painfully abridged, although the subject affords opportunity for a most interesting, valuable, and necessary article, explanatory of the instrument's care on shore and at sea, its rate, etc. Again on page 234, vol. 1, where the meridian altitude is treated, the reader is directed to "keep the sun touching the horizon until it ceases to rise—you then have the meridian altitude on your sextant." The amateur for whose benefit the book is mainly written might be pardoned for failing to manipulate the meridian altitude with much satisfaction or profit on the strength of such an impoverished rule.

On pages 273 and 274, vol. 1, a most unnecessary and clumsy explanation is recommended for finding the hour at Greenwich at the instant of taking an observation. Directions are given for working up the ship's longitude by dead reckoning, turning it into time, and applying it to the face of the ship's clock. Why all this work? What is to prevent looking at the chronometer when the sight is taken?—that instrument carrying the Greenwich time, will, on its face, give the time at the prime meridian, without the navigator taking the trouble to go all the way around the block to get next door.

In the first sentence in vol. 2, the author states: "Sumner lines are so called after Captain Sumner, of the United States Navy." This is an unimportant error, but in passing it may be mentioned that Captain Sumner was a merchant and not a naval officer.

Spherical trigonometry next occupies the attention, and in this treatise, as in his chapter on plane trigonometry, the author has succeeded in giving valuable homely wording to the usual scientific formulæ. Stellar work follows, and several rules advanced for finding the latitude are unnecessarily long and complicated, but perfectly consistent with English methods of navigation. It is a characteristic of American navigators to "get home first" by short cuts which are calculated to horrify the average conservative nautical Briton, wedded as the latter is to the long drawn out navigation problems of his grand-sires. The deviation of ship's compasses is gone into at some length, but nothing new or original is advanced, and the treatment of the subject is strictly conventional and in accordance with the common rules laid down by various writers, concerning whom, Captain Squire Lecky, a celebrated English sailor-author, has probably furnished the best treatise extant on the mariner's compass, its magnetism, irregularities and compensations.

The law of storms is rationally considered, and the book concludes with a chapter on "the formulas used in nautical astronomy," and numerous exercises, with answers, for the benefit and edification of the amateur and professional reader.

In summing up the work it must be conscientiously admitted that it is an acceptable addition to nautical literature; that it possesses some excellent features in the way of original and pat explanations, and that it will prove valuable to a class of unscientific and unmathematical navigators anxious to know the "why and wherefore" of many figures and methods employed by them in their daily work while sailing along the coast-line, or when the bare horizon line comprehends their vision. The illustrations are not numerous, but those shown are so well executed and explanatory that it promotes a desire for more.

QUERIES AND ANSWERS.

Q.—(1) What is the total and latent heat in steam at 60 lb. gauge pressure?

(2) How is the steam and water space determined in a boiler?

(3) What lift would you give a check valve?

(4) What is the horsepower of an engine 22 in. by 24 in., 90 lb. steam pressure, 125 revolutions, cut off 1-2 stroke.

(5) How is the diameter of steam and exhaust pipes found when the area of the ports is known?

A.—(1) By consulting any standard steam tables you will find that the total heat in steam per pound at 60 lb. gauge pressure is 1,175.7 British thermal units, or say 1,176, while the latent heat under the same conditions is 859.

(2) The steam and water space in a boiler depend entirely on the type, both being much less in a water-tube than in a fire-tube boiler. The water space is not directly determined or provided for, but results from the type and design of the boiler. In fire-tube boilers with modern triple expansion engines it is a safe rule to allow from .3 to .35 cubic ft. steam space per I. H. P. developed.

(3) The lift to be given a check valve cannot be expressed in any general terms, nor does it depend especially on the speed of the feed pump. The nearest approach to a rule is to have the lift about 1-4 the diameter of the feed pipe.

(4) You do not state whether the engine is condensing or non-condensing, nor whether the pressure you give is gauge or absolute. We will take the engine as condensing, and 90 lb. as gauge pressure. Then with cut-off at half stroke, making fair allowance for the effect of the clearance, we should have about 1.8 expansions. We then find the mean forward pressure of an ideal card by the formula:

$$p = 105\,(1 + log_e\ 1.8) \div 1.8.$$

The natural logarithm of 1.8 is taken from a table and found to be .588. Then substituting we find $p = 92.4$. From this we must subtract the back pressure, say 4 lb., leaving 88.4. This is what an ideal card without loss by wiredrawing, rounding off, or compression would give. Actually we shall realize about .9 of this or say 80 lb. as the mean effective pressure for the stroke.

Also the area of the piston 22 in. diamater is 380 sq. in., and the stroke is 2 ft.

The usual H. P. formula is

$$H = 2\,pLAN \div 33000.$$

Where P = mean pressure.
L = length of stroke in ft.
A = area of piston in square inches.
N = revolutions per minute.

Substituting the values given we have:

$$I.H.P. = 2 \times 80 \times 2 \times 380 \times 125 \div 33000.$$

And working this out we find

$$I.H.P. = 466$$

(5) The area of steam pipe is usually made about the same as that of the ports, or if anything a little larger. The area of exhaust pipes may be made about 1.5 times that of the steam ports.

The *Shipping World Year Book* for 1901 has been issued by the *Shipping World*, London, England. For those engaged in the foreign trade it is invaluable.